Remedial Alternative 9 would comply with these requirements.

Remedial Alternative 9 would comply with ARARs for the carbonaceous material in the carbon run-off and deposition area. Under this remedial alternative, these materials would be excavated and transported to an off-site landfill for disposal. Any material that is transported off-site for disposal will be appropriately characterized to determine its status relative to the RCRA Land Disposal Restrictions.

6.10.1.2 Location-Specific ARARs

Remedial Alternative 9 would comply with federal and state location-specific ARARs regarding location criteria for solid waste landfills. As identified in Table 1-1, these criteria specify locations in which solid waste landfills are not to be cited, such as floodplains. This ARAR does not require the removal of existing landfills. The 100-year floodplain requirement set forth in OAC 3745-27-07 (A,B) prospectively prohibits the deposition of solid wastes in a floodplain. The floodplain requirement is not retrospective, and USEPA guidance recognizes that it is not appropriate to remove large existing landfills from the floodplain[99]. The side slopes of the CMSD bordering the Ohio River and the Outfall 004 backwater area are currently situated within the 100-year floodplain of the Ohio River. The 100-year flood elevation is defined by the Federal Emergency Management Agency (FEMA) as the elevation having a 1% chance of being equaled or exceeded in any given year.

The Floodplain Protection Policies (40 CFR6, Appendix A, and the Fish & Wildlife Coordination Act, 16 USC 661 et seq) are TBCs for the Ormet site. The substantive requirements of these TBCs are potentially relevant to any activities undertaken by the Federal government.

[99]USEPA, 1988d.

Under this remedial alternative, the side slopes of the CMSD would be largely removed from the 100-year floodplain by regrading. These actions would be protective of human health and the environment, however a small portion of the material in the CMSD would remain below the 100-year floodplain elevation of 637.5 feet. This 2.5 foot high portion of the CMSD sideslopes would be protected from erosion damage by placement of a riprap barrier along the toe of the CMSD (see Figure 5-9).

Remedial Alternative 9 would comply with ARARs for the carbonaceous material in the carbon run-off and deposition area. Under this remedial alternative, these materials would be excavated, treated by solidification, and disposed off-site at a landfill. These actions would physically remove the carbonaceous materials from the 100-year floodplain.

6.10.1.3 Action-Specific ARARs

Implementation of this remedial alternative would require attaining various action-specific ARARs. Operation of the Ormet Ranney well and new interceptor wells would also be subject to certain action-specific ARARs under Remedial Alternative 9. Specific maintenance requirements for ground-water casings, pumps, and wells (in general) are set forth in OAC 3745-9-09. This remedial alternative would comply with these requirements.

Treatment of the interceptor well water under Remedial Alternative 9 would also be subject to action-specific ARARs. This remedial alternative would comply with any permit-to-install requirements, as well as operational, maintenance, and monitoring requirements under a NPDES permit.

Treatment of the materials contained within the CMSD by thermal oxidation utilizing a transportable rotary kiln incinerator would comply with action-specific ARARs. Specifically, rotary kiln incineration of these wastes would comply with the design and performance standards for incineration. This type of incinerator would be capable of achieving the Destruction and Removal Efficiency (DRE) specified for the incinerator, if any.

Under Remedial Alternative 9, off-site landfilling of the excavated soils from the former spent potliner storage area, carbonaceous material from the carbon run-off and deposition area, the solidified sediments, and ground-water treatment residuals would be subject to action-specific ARARs regarding waste characterization. Remedial Alternative 9 would comply with these requirements. Depending on the outcome of the waste characterization, Remedial Alternative 9 may be subject to various transportation and disposal requirements.

Remedial Alternative 9 would be subject to various relevant and appropriate action-specific requirements relating to thermal treatment of the materials in the CMSD. The specific design and performance standards for incineration that are relevant and appropriate under Remedial Alternative 9 are as follows:

- OAC 3745-50-44(C8): Substantive permit requirements for incineration.

- OAC 3745-50-62(A-D): Specifies trial burn requirements for incinerators.

- ORC 3734.02(I): Establishes air emission requirements for particulate matter, dust, fumes, gas, mist, smoke, vapor, and odorous substances.

- OAC 3745-15-07(A): Defines and prohibits air pollution nuisances.

- OAC 3745-16-02(B,C): Establishes allowable stack height requirements for air emission sources based on good engineering practice.

- OAC 3745-23-06: Establishes requirements for minimization of nitrogen oxide emissions from stationary sources.

- OAC 3745-23-04: Prohibits the significant and avoidable deterioration of air quality by the release of nitrogen oxide emissions.

Remedial Alternative 9 would comply with the majority of these requirements. However, thermal treatment of media containing elevated cyanide concentrations would result in emissions of nitrogen gas. Appreciable amounts of NO_x may exist[100]. Monroe County is in attainment for NO_x and would be covered by the NO_x non-degradation ARAR. Commercially available transportable rotary kiln incinerators are not equipped with air pollution control equipment to remove NO_x. However, air pollution control equipment could be added to the incinerator to reduce NO_x emissions. Therefore, this remedial alternative would achieve compliance with the NO_x non-degradation ARAR.

The single barrier synthetic caps that would be constructed over the CMSD and FSPSA would attain or exceed State of Ohio Solid Waste ARARs. As provided in OAC 3745-27-11(G)(1), the cap designs illustrated in Section 5 would include materials of construction that are comparable to those identified to meet, or be equivalent to, the cap construction requirements under OAC 3745-27-08 and 3745-27-11.

The cap that would be constructed over the FDPs would attain RCRA Subtitle C and State of Ohio ARARs pertaining to closure of hazardous waste facilities. The dual barrier cap design illustrated in Section 5 would meet, or be equivalent to, the cap construction requirements specified under RCRA Subtitle C (40 CFR 264.228 and 40CFR264.221) and OAC 3745-57-10.

Capping the CMSD under this remedial alternative would not necessitate explosive gas monitoring because construction materials are generally not putrescible. Wooden scrap that was emplaced in the CMSD is putrescible, however, visual observations during test pit excavation confirmed that this material only makes up a small portion of the CMSD. Furthermore, wooden

[100]Kiang and Metry, 1982.

scrap would not be likely to putrefy at a rate sufficient to generate explosive gases within the CMSD. Air monitoring performed during test pit excavation in the CMSD did not detect the presence of explosive gases.

Remedial measures for the sediments in the Outfall 004 backwater area under this alternative would attain action-specific ARARs regarding PCBs. Under this alternative, sediments containing PCBs at concentrations greater than the SQC would be excavated from the backwater area and disposed of in an off-site landfill. Excavated material containing greater than 50 mg/kg PCBs, if any, would necessitate disposal at a chemical waste landfill approved under TSCA. Following removal, the excavated area would be sampled to confirm that the PCBs had been completely removed.

6.10.2 Overall Protection

The protectiveness of Remedial Alternative 9 for human health and the environment would be very similar to Remedial Alternatives 3 through 8. The potential human health exposure pathways include:

- inhalation of airborne dusts from the former spent potliner storage area and the former disposal ponds;
- ingestion of contaminated media from all areas of concern;
- direct contact with contaminated media from all areas of concern;

These exposure pathways would be effectively addressed under Remedial Alternative 9 for all areas.

6.10.3 Short-Term Effectiveness

This remedial alternative would be protective of human health and the environment in the short-term. The short-term effectiveness associated with implementation of Remedial Alternative 9 is described in the following sections.

6.10.3.1 Time Until Protection is Achieved

The protection associated with Remedial Alternative 9 could be achievable within 12 to 14 years following remedy selection. Once the containment structures under this remedial alternative are constructed, the remedial action objectives would be achieved by blocking direct exposure pathways of inhalation and ingestion. Containment of the ground-water plume would be achieved immediately because pumping of the Ormet Ranney well represents current conditions. Effective treatment of the extracted ground water from the new interceptor wells may be achievable, pending treatability testing using ground-water pumped from the new interceptor wells, final design of the treatment system, and construction and shakedown of the treatment plant. The timeframe for this component of Remedial Alternative 9 is estimated to be 2 to 3 years.

Some of the elements of this remedial alternative could potentially achieve protection within a very short timeframe. Collection and treatment of the CMSD seeps falls within this category. In consideration of the relative simplicity of the treatment system for the CMSD seeps, design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Furthermore, it is possible that the seeps would eventually disappear after capping of the CMSD. Excavation of the 4,000 CY of soil from the former spent potliner storage area could be implemented in 1 to 2 years.

Remedial Alternative 9 includes solidification of the solids in the former disposal ponds prior to capping, and solidification of the dredged sediments from the Outfall 004 backwater area prior to off-site landfilling. Processing rates for in-situ solidification using backhoes for mixing are approximately 1200 CY per eight hour day[101]. Solidification of the pond solids would therefore require approximately 1 to 2 years. Solidification of the 2,000 CY of excavated sediments from the Outfall 004 backwater area would be performed ex-situ using the same equipment that would be employed for solidification of the pond solids. The time required to solidify the sediments would be very short.

Inquiries to vendors of transportable rotary kiln incinerators indicated that thermal treatment processing rates are highly variable and can range from 100 to 225 tons per day. Assuming a density of 1.5 tons per cubic yard, approximately 4 to 10 years would be required for treatment of the CMSD. The timeframe for this remedial measure would be expected to be in the upper portion of this range due to the need to pre-process the material in the CMSD prior to thermal treatment.

Remedial Alternative 9 includes excavation and off-site landfill disposal of area of greater relative cyanide concentration soils from the former spent potliner storage area, the carbonaceous materials from the carbon run-off and deposition area, and the sediments associated with the Ormet site. The protectiveness of the excavation and landfill disposal components of Remedial Alternative 9 could potentially be achieved within two years. Administrative requirements governing permitting of dredging activities under this remedial alternative would extend the timeframe for achieving protection. The extent of this increase in the time required for implementation is not known, but may be on the order of one to three years.

Remedial Alternative 9 also involves several containment structures, including single barrier synthetic caps, steel sheet piling, and a dual barrier cap over the former disposal ponds. These structures could be constructed within 2 to 3 years. The estimated construction time for capping was developed assuming sequential capping of the former spent potliner storage area,

[101]Cullinane, et. al, 1986.

the former disposal ponds, the CMSD, and containment of the Outfall 004 backwater area sediments.

6.10.3.2 Short-Term Reliability

The short-term reliability of Remedial Alternative 9 is unknown, due to the uncertainty regarding the ability to treat ground water from interceptor wells placed closer to the source. Under Remedial Alternative 9, containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well (installed in 1958) and the new interceptor wells. The Ranney well has operated reliably since its installation and would continue to do so under this remedial alternative. The Ormet Ranney well is equipped with three 150 HP pumps and the interceptor wells are each equipped with a 25 HP submersible pump. Under normal operations, one of the pumps in the Ormet Ranney well is operated. Therefore, the ground-water containment system currently has in-line redundancy to ensure reliable, continuous operation.

Solidification of the pond solids and sediments, and containment of the former spent potliner storage area, the former disposal ponds, and the CMSD would not be performed in the short-term under Remedial Alternative 9. As discussed in Section 6.10.3.1, approximately 1 to 2 years will be required for solidification of the pond solids and sediments. Approximately 2 to 3 years will be required for containment of these areas. Therefore, solidification and containment of these areas would be initiated in the mid-term, and would continue over the long-term. The reliability of this component of Remedial Alternative 9 is addressed in Section 6.10.4.3.

Thermal treatment of the materials from the CMSD and the carbon run-off and deposition area under this remedial alternative would not be performed in the short-term. As discussed in Section 6.10.3.1, thermal treatment would require approximately four to ten years for implementation under this alternative. Thermal treatment would be initiated in the mid-term, and would continue over the long-term. The reliability of the treatment component of this alternative is addressed in Section 6.10.4.3.

Excavation and off-site landfill disposal of soil in the area of greater relative cyanide concentration from the former spent potliner storage area, and the carbonaceous materials from the carbon run-off and deposition area would be reliable over the short-term. Placing these media in an off-site landfill would provide a reliable means of isolation and containment. Off-site landfills typically achieve this short-term reliability through the use of liner systems, leachate detection and collection systems, specific operating procedures regarding placement, and capping systems. These features contribute to the short-term reliability of the off-site disposal component of Remedial Alternative 9. Dredging and off-site landfill disposal of the sediments associated with the Ormet site would probably occur during the mid-term due to the potentially extended timeframe for obtaining approvals to implement this work.

During dredging, the sediments would be contained using silt curtains and sheet piling. The currents of the Ohio River during high flow periods (March)[102] may not be suitable for deployment of silt curtains. Literature indicates that silt curtains work best when the currents are less than one knot. Since containment would only be needed near the bank of the Ohio River and the site is situated on the inside of a meander, river current in the vicinity of the Ormet site may not exceed one knot. Silt curtains may therefore be effective in controlling transport of the sediments. Both of these operational controls are effective in the short-term. Sediment captured by the barriers would be removed and disposed of properly.

[102]U.S. Army Corps of Engineers, 1991.

6.10.3.3 Community Protection

Implementation of this remedial alternative would not adversely impact the health or safety of the community during the construction period. The treatment and containment components of Remedial Alternative 9 will require regrading of the CMSD, the former spent potliner storage area, and the former disposal ponds, as well as solidification of the material in the former disposal ponds and the dredged sediments. Additionally, the sediments in the Outfall 004 backwater area would be dredged and the carbonaceous material from the CRDA would be excavated and transported off-site for disposal. These activities could potentially result in airborne emissions of dust and other substances. However, as discussed in Section 4, these emissions would be effectively controlled through application of dust suppressants such as water, anhydrous calcium chloride, or foam.

Under this remedial alternative, ground water extracted by the existing interceptor wells would continue to be discharged to the Ohio River via Outfall 004, pending completion of treatability studies to evaluate the feasibility of treating ground water pumped from interceptor wells placed closer to the source. These activities would not adversely impact the community over the short-term because river water in this area is not used for drinking purposes and recreational uses in the vicinity of the site are minimal. Additionally, bioassay testing of the Outfall 004 water, which includes ground water extracted by the existing interceptor wells demonstrated that this water is not acutely toxic to aquatic organisms.

Implementation of this remedial alternative would result in air emissions from the thermal treatment equipment. Air pollution control equipment would be added to reduce NO_x emissions. This alternative would be protective of the health and safety of the community because of the air pollution controls that would be utilized.

The silt curtains and sheet piling utilized as operational controls for dredging will effectively contain sediments and safeguard areas used for recreation within the river. Therefore, these operational controls will aid in protecting the community during dredging operations.

There is no possibility that implementation of this alternative would generate toxic gases. Ground-water treatment would be performed at alkaline pH, therefore, the generation of HCN gas is not possible. None of the other treatment or containment components of this alternative would result in the possible generation of toxic reaction by-products.

6.10.3.4 Worker Protection

Implementation of Remedial Alternative 9 would be protective of workers involved in remedial construction activities. Workers associated with remedial construction activities under this alternative would require training and medical monitoring in accordance with 29 CFR 1910.120. Additionally, these workers would be required to utilize protective clothing and respiratory equipment as specified in a site-specific health and safety plan. Operational controls (i.e., work zones, decontamination facilities, air monitoring, etc.) would be established to further protect workers during the construction period.

Dust suppressants would be used during the excavation of the FSPSA, CMSD and CRDA to restrict fugitive dust emissions. Dredging of the Outfall 004 backwater sediments is not expected to generate significant dust unless the sediments are allowed to dry, at which point dust suppressants may also be used on the sediments. Given the large amount of excavation activity, the possibility for fugitive dust generation is high. However, because dust suppressants would be utilized the amount of dust possibly generated cannot be estimated, but inhalation exposure during the periods of excavation and transfer are expected to be minimal. Appropriate protective equipment would be utilized during the period of excavation and material handling to provide additional protection of the workers.

6.10.3.5 Environmental Impacts

Construction of the various components of this remedial alternative will result in short-term environmental impacts at the site, which may include the following:

- Disruption of natural drainage patterns;
- Generation of dust and noise;
- Increased sediment runoff;
- Installation of temporary roads and utilities;
- Resuspension of sediments; and
- Construction of temporary staging and vehicle maintenance areas.

These impacts will be minimized through the use of standard construction and engineering practices, including the use of runon-runoff controls, silt fences and sedimentation basins, dust suppresants, silt curtains, and general good housekeeping practices. The actual measures to be taken to address potential environmental impacts during remedy construction will be determined during remedial design. The costs associated with these measures have been factored into the estimated cost for this remedial alternative.

6.10.4 Long-Term Effectiveness

This remedial alternative would be protective of human health and the environment over the long-term. Long-term effectiveness considerations associated with implementation of Remedial Alternative 9 are discussed in the following sections.

Ground-water remediation and aquifer restoration at the Ormet site will be a long-term program, probably in terms of decades. This remedial alternative includes ground-water remedial measure GW-5, which consists of pumping of the Ormet Ranney well and new interceptor wells to control and recover the plume, followed by treatment of the ground water extracted by the interceptor wells prior to discharge to the Ohio River. Although at this point in time an exact prediction of the duration of ground-water remediation is not possible, estimates of the timeframe required to accomplish aquifer restoration can be refined as the remedial program progresses. Over the past 9 years of monitoring, the available data indicate that there has already been an improvement in the quality of ground water pumped from the existing interceptor well system (see Appendix A). To facilitate the comparison of alternatives presented in this FS, the time that may be required to reduce concentrations of total cyanide in ground water pumped by the new interceptor wells to 0.1 mg/L has been roughly projected to be 36 years under current site conditions. A more detailed discussion of the calculations, data, and assumptions used to project reductions in cyanide concentrations is provided in Appendix K. Installation of the caps as source control measures under Remedial Alternative 9 is expected to decrease this time frame, as infiltration of precipitation through the unsaturated soils would be virtually eliminated. However, due to fluctuations in the water able elevation over time and the consequent contract of ground water with unflushed soils, the extent to which aquifer restoration times may be reduced by the caps is uncertain.

This alternative would be effective in reducing the infiltration of precipitation through the soils of the former spent potliner storage area, the solids in the former disposal ponds, and the wastes in the CMSD. Regrading of the site and construction of the dual barrier and single barrier synthetic caps would promote run-off and evapotranspiration. Infiltration modelling was performed for the single synthetic barrier caps (see Appendices I and J). For the FSPSA, regrading and construction of the single barrier cap would only allow 0.17 percent of the incident precipitation to infiltrate. This equates to approximately a 99.5 percent decrease in infiltration over existing conditions. For the CMSD, regrading and construction of a single barrier cap would only allow 0.17 percent of the incident precipitation to infiltrate. This equates to a 99.4 percent reduction over existing conditions. This alternative would be effective in reducing the infiltration of precipitation through the soils in the former disposal ponds. Regrading of the ponds and construction of the dual barrier caps over the FDPs would promote run-off and evapotranspiration to the same extent as the dual barrier caps discussed in Section 6.5.4. Based on these results, leachate generation in these areas would be virtually eliminated

6.10.4.1 Reduction of Assumed Existing Risks

Similar to Remedial Alternative 2, implementation of Remedial Alternative 9 would reduce the existing human health and environmental risks (as assumed in the Baseline Risk Assessment) by addressing the potential for exposure. Exposure to the constituents detected in the affected media would be eliminated by the construction of the single barrier and dual barrier caps. Direct contact with the media beneath the caps would be precluded and emission of fugitive dust would not occur. There would be no exposure to the impacted media beneath the single barrier or dual barrier caps, therefore, the risks would be zero.

Ground-water risks were not identified as an existing risk at the site. Pumping of the interceptor wells and treatment of the captured ground-water would continue to prevent current exposure to the ground water beneath the site. This containment system is equally effective in addressing the constituents detected in the ground water from past releases from the site, as well as any additional leaching that might occur through the caps.

Collection of the seep water in the trenches and discharge to the Ohio River following treatment, if necessary, to acceptable discharge levels would preclude exposure to the seep waters by trespassers or terrestrial animals. The exposure pathways for the seep waters would be eliminated, therefore, the risks associated with the seep waters would be zero.

Complete dredging of the sediments from the Outfall 004 backwater area, followed by solidification and off-site landfilling, would prevent direct exposure to constituents in sediments and prevent future releases from the backwater area to the river. Human and wildlife exposure to the backwater sediments would be eliminated, therefore, the risks would be zero. Exposure of fish in the Ohio River from these sediments would also be eliminated. Therefore, the risk to humans associated with ingestion of fish that may have bioaccumulated constituents from the Ormet site would be zero.

Constituent concentrations in the sediments of the Ohio River are expected to decline as the Outfall 004 backwater area is dredged and landfilled, and as natural sedimentation processes cover up the impacted sediments. Relatively rapid sedimentation is consistent with the fact that the site is located on the inside of a meander in the river and the river currents adjacent to the site would be less than elsewhere in the river channel. Furthermore, the site is situated upstream of the Hannibal Lock and Dam and as such, the large quantity of water pooled behind the dam would promote siltation. Therefore, the risks for a trespasser are expected to decrease over time as the sediments are covered by background river sediments. Constituents in the Outfall 004 backwater area would be removed, therefore, the risk values in the baseline risk assessment would no longer be appropriate.

6.10.4.2 Magnitude of Future Risks

Similar to Remedial Alternative 2, constituents in the alluvial ground water would be collected and treated under Remedial Alternative 9. Future hypothetical exposure of plant workers, maintenance worker, and residents to the ground water by ingestion would be precluded by the containment and treatment of the ground water extracted by the interceptor wells, and by the establishment of a deed restriction on the property that would preclude use of contaminated ground water as a source of potable water.

Trench drains would effectively collect seeps at the ballfield and CMSD. Future exposure of child and adult residents to the seep water would be eliminated by these actions.

Pumping and treatment of the impacted ground water, collection of the seep water in trench drains, combined with the deed restrictions on future land use would effectively eliminate the potential for future exposure of plant workers, maintenance workers, and residents by ingestion of the constituents in the ground water. This would include eliminating the potential for exposure to any constituents that might still leach from the underlying media after the single barrier and dual barrier caps are installed. Therefore, in the absence of an exposure pathway, the potential future risks associated with the ground water are zero.

Single barrier synthetic caps on the former spent potliner storage area and the CMSD (with the consolidated and treated carbonaceous material from the carbon run-off and deposition area), and the dual barrier cap on the former disposal ponds, would prevent the emission of fugitive dust and eliminate direct contact exposure to the impacted soils. The single barrier and dual barrier caps over these areas would preclude future exposure by inhalation of the constituents and would thereby eliminate future risks to humans or terrestrial wildlife. With the exception of deep burrowing animals, the single barrier and dual barrier cap would preclude exposure of most terrestrial organisms. It is possible that the affected media may also act as a deterrent to burrowing animal activity. The single barrier and dual barrier caps form physical barriers that would preclude phytotoxicity to all but the deepest rooting plants such as trees. An aspect of the maintenance of the single barrier and dual barrier caps would include control of burrowing animals and removal of seedling trees that might take root at the site. Infiltration through the caps could mobilize some of the constituents in the subsurface soils, however, as discussed in the preceding paragraph, these constituents would pose zero risks to humans or wildlife.

Complete dredging of the Outfall 004 backwater sediments and off-site landfilling would eliminate the potential for future exposure to constituents in the sediments. Because the 004 backwater area is an embayment of the Ohio River, relocation of the 004 outfall stream prior to sediment removal would not eliminate benthic habitat. Dredging of the sediments would temporarily disrupt the benthic habitat in the backwater area. However, because the backwater area is an embayment, resedimentation and the associated restoration of benthic habitat would occur relatively rapidly. The overall effect of these actions would be that exposure to constituents in the backwater area would be eliminated. Food chain exposures associated with the Outfall 004 backwater area would also be essentially eliminated. Dredging of the Outfall 004 backwater area would eliminate the potential for future releases to the Ohio River, and natural sedimentation processes in the river would cover the impacted sediments with background river sediments. Therefore, the potential for direct exposure and aquatic food chain exposure would decrease as the depth of background river sediments covering the impacted sediments increases.

In summary, the remedial measures that comprise Remedial Alternative 9 would eliminate or significantly reduce the potential for exposure, and the potential future risks to humans and the environment would be reduced to acceptable levels.

6.10.4.3 Long-Term Reliability

Remedial Alternative 9 would be reliable over the long-term. As discussed in Section 6.10.3.2, containment of the ground-water plume through continued pumping of the Ormet Ranney well has performed reliably since installation of the Ranney well. In consideration of the in-line redundancy of the Ranney well, ground-water containment over the long-term is expected to be highly reliable. Operation of new interceptor wells installed closer to the source also would be expected to be reliable over the long term, although frequent maintenance may be associated with the new interceptor wells (see 6.10.6.1.).

Treatment of the pond solids and sediments by solidification may not be reliable over the long-term because solidified materials can be subject to breakdown due to natural weathering. Cullinane suggests that a minimum unconfined uncompressive strength of 50 pounds per square inch (psi) be considered as a measure of adequate bonding for solidified materials. Durability standards have not been established for solidified materials, however, a 15 percent weight loss is considered an acceptable amount. Sulfate-rich ground water can cause swelling and disintegration of flyash solidified materials. Additionally, leaching by rainwater can remove buffering materials in a solidified material and allow the pH to decrease such that metals are solubilized by the contacting water[103]. Capping the former disposal ponds would aid in maintaining the long-term reliability of Remedial Alternative 9 by preventing weathering of the solidified materials.

No substantial uncertainties have been identified regarding off-site land disposal of soil from the former spent potliner storage area that would require special long-term considerations.

Pending results of treatability testing to evaluate the effectiveness of treatment of ground water from the new interceptor wells, treatment of the interceptor well water under Remedial Alternative 9 may be reliable over the long-term.

However, the operational variability associated with precipitation by lime/ferrous salts would be exacerbated by ground water from new interceptor wells and additional unit operations (i.e., activated alumina adsorption) in the treatment train. Pilot studies have demonstrated that precipitation using lime and ferrous salts is a complex process requiring careful process control[104]. Operational variability was found to be common during the pilot studies, apparently due to the complicated precipitation chemistry for cyanide complexes. Further complicating the ground-water treatment train by adding additional operations for post-treatment using activated alumina adsorption would necessitate a greater level of process control. The equipment that would be utilized under this remedial alternative could be reliably maintained over the long-term.

The long-term reliability of dual barrier caps utilizing clay and/or synthetic membrane materials of construction has been proven, dependent upon adequate post-closure maintenance.

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[103]Cullinane, et.al, 1986.

[104]Baker/TSA, Inc. 1990.

Single barrier caps employing synthetic membranes as materials of construction have also been proven to be reliable over the long term. The reliable life expectancy of a RCRA (i.e., dual barrier) cap and a standard (i.e., single barrier) landfill cap with normal maintenance is approximately 50 to 100 years (Versar, Inc., 1991). These caps are susceptible to settlement and cracking, wind and water erosion, root penetration, burrowing animals, and accidental or intentional intrusion. Proper QA/QC during cap construction can greatly reduce the potential for damage to the cap. Standard engineering practice of installing geotextile fabric between the vegetated layer and drainage layer, coupled with vegetating the cover with grasses that do not have deep roots, will aid in preventing root penetration. Animals that currently live on-site would be baited prior to capping (OAC 3745-27-11 (G)(4)). The geotextile fabric and geonet will also aid in preventing the animals from burrowing into the cap. A well-maintained vegetative cover, periodic inspections and limited site access will ensure reliable long-term performance of the single and dual barrier caps. Synthetic membranes exhibit a high degree of chemical resistance and are capable of elongating up to 500 percent (National Sanitation Foundation Standard Number 54). Unless atypical settlement occurs, the integrity of the synthetic membrane cap component will not be compromised by subsidence.

CERCLA requires a five year review whenever the selected remedy will leave wastes on site above levels that allow for unlimited use and unrestricted exposure. Under this alternative, wastes will be left on site; therefore, a five year review would be required.

6.10.4.4 Prevention of Future Exposure

As discussed previously, pumping of the Ormet Ranney and the interceptor wells will effectively contain the ground water plume under the Ormet site. Treatment of the ground water extracted by the interceptor wells by precipitation using lime/ferrous salts, followed by activated alumina adsorption, will reduce the constituent concentrations in the extracted ground water.

Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. As discussed in Section 6.10.4, regarding the remediation of ground water, restoration of ground-water quality will require an extended period of time. Therefore, under the hypothetical future residential use scenario evaluated in the BRA, there would be a potential for exposure to contaminated ground water through an on-site drinking water well until restoration of the aquifer is achieved. Institutional controls could be imposed to prevent future residential use of the property.

Capping with single and dual barrier caps will eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration by transport. Therefore, Remedial Alternative 9 will eliminate or significantly reduce potential future exposures to the constituents present at the Ormet site.

6.10.4.5 Potential for Replacement

Due to the high degree of long-term reliability for the ground-water extraction and treatment components of this remedial alternative, the potential need to replace these components over the long-term is low. Potential for repair of single and dual barrier caps will be limited to periodic maintenance of the soil cover. Periodic maintenance would include checking perimeter fencing, checking for soil subsidence and erosion, baiting for animals (OAC 3745-27-11 (G)(4)), and removal of trees. Proper site inspection, maintenance, and security would serve to reduce the potential for more extensive repair or replacement of the cap components.

6.10.5 Reduction of Mobility, Toxicity, and Volume

Remedial Alternative 9 would result in removal of constituents for the ground water extracted by the interceptor wells, as well as for the CMSD seeps. Toxicity reductions would also result from thermal treatment of the carbonaceous material from the carbon run-off and deposition area and the materials in the CMSD. Limited volume reductions would result from implementation of Remedial Alternative 9. Volume reduction of the materials in the CMSD would result from pre-processing for size reduction. Little volume reduction would result from thermal treatment of this material because of the predominant presence of firebrick and other inert materials that would not be combusted. The partial excavation of soils from the former spent potliner storage area would reduce the volume, however, there would be no net volume reduction to the environment because the soil would be relocated for off-site disposal.

Solidification of the solids in the former disposal ponds and the sediments would be performed primarily to improve geotechnical properties. This treatment would increase the volume of these materials by 25 to 75 percent. For example, the 370,000 CY present in Pond 5 would increase to approximately 460,000 to 650,000 CY (Table 6-13). Due to the volumetric increase resulting from solidification, additional material would not be required to fill the ponds to grade for capping under this remedial alternative. Secondarily, the mobility of the various organic and inorganic constituents present in the solids from the former disposal ponds and sediments would be reduced by solidification. Constituent mobility would not be reduced for the former spent potliner storage area and CMSD. However, the containment barriers that would be provided for these areas under Remedial Alternative 9 would effectively block transport pathways.

6.10.5.1 Quantities Treated or Destroyed

Ground water extracted by the interceptor wells is one of several media that would undergo treatment or destruction under this remedial alternative. As discussed in Appendix K,the quantity of ground water that would be pumped by two additional interceptor wells located at the downgradient edge of the FSPSA is estimated to be 54 gpm (78,000 GPD).

Based on the estimated maximum seep flowrate of 5 gpm, the total quantity of seep water that would be collected under this remedial alternative is less than 2.7 million gallons per year. Assuming that 50 percent of this water emanates from the toe of the CMSD, the total quantity of seep water that would undergo treatment under this alternative is approximately 1.3 million gallons per year. However, it is possible that the seeps would eventually disappear after capping of the CMSD.

As discussed in Section 2.4, the former disposal ponds contain approximately 420,000 CY of solids that will be solidified prior to capping. Approximately 2,000 CY of sediments will be solidified prior to off-site landfilling under Remedial Alternative 9.

The excavated soils from the former spent potliner storage area would not undergo treatment of destruction under Remedial Alternative 9 as will the material excavated form the CRDA and subsequently disposed of off-site.

This remedial alternative would include treatment of approximately 228,000 CY of material from the CMSD. This quantity represents the total quantity of material in the CMSD (240,000 CY) less the quantity of bulky materials that would be sorted out prior to thermal treatment (12,000 CY). As discussed in Section 5, the sorted materials would be addressed by off-site landfilling.

6.10.5.2 Degree of Expected Reductions

Treatment of the ground-water extracted by the existing interceptor wells has been shown to remove cyanide, fluoride, and color. As discussed in Section 3.2.3.3, influent cyanide concentrations of 5.5 to 9.6 mg/L were reduced to effluent concentrations of 0.19 to 0.89 mg/L[105]. This corresponds to a cyanide removal efficiency of 96.5 to 99.1 percent. Influent fluoride concentrations of 23 to 34 mg/L were reduced under carefully controlled pilot plant conditions to 10 to 15 mg/L[106]. This corresponds to a fluoride removal efficiency in the range of 55 to 58 percent. Post-treatment of ground water by activated alumina adsorption could potentially reduce fluoride concentrations further, although the extent of this reduction is not known. Color removal was determined qualitatively by visual observation. Tea-colored influent was associated with a clear effluent. The effectiveness of the treatment system using ground water pumped from wells closer to the source would need to be evaluated through extensive treatability testing.

Under this remedial alternative, oils present in the CMSD seeps would be removed by oil/water separation. Vendor literature indicates that effluent oil and grease concentrations of 10 mg/L are achievable. Dissolved PCBs, if any, present in the separator effluent would be removed by activated carbon adsorption. Activated carbon is highly efficient for removing PCBs.

As discussed in Section 5, solidification of the pond solids and sediments from the Outfall 004 backwater area under Remedial Alternative 9 would be achieved using pozzolanic materials

[105]Baker/TSA, Inc., 1990.

[106]Baker/TSA, Inc., 1990.

such as lime and fly ash. Solidification utilizing pozzolanic materials has been shown to be effective for metal sludges[107].

Thermal treatment of approximately 228,000 CY of material from the CMSD would yield significant concentration reductions for organics and cyanide present in the CMSD. A Destruction and Removal Efficiency (DRE) of 99.99% could be achieved for these substances using a transportable rotary kiln incinerator.

After thermal treatment, a single barrier cap over the CMSD would be constructed. Infiltration would be reduced thus eliminating or significantly decreasing generation of the seeps. Following capping, the seeps may stop discharging entirely.

6.10.5.3 Permanence of Treatment

Cyanide and fluoride precipitation utilized in the ground-water treatment system is a permanent treatment. The cyanide and fluoride would be precipitated into a sludge and the sludge would be removed from the system and disposed off-site. Treatment of the CMSD seeps by oil/water separation is also a permanent treatment. The treatment residuals from this treatment process would include free-phase oil and spent activated carbon that may contain PCBs.

Reduction of the pH of solidified materials can cause resolubilization of metals. Natural weathering can also cause the solidified material to physically disintegrate as mechanical strength is reduced through chemical reactions. Standards have not been established for performing durability tests on solidified materials. However, a 15 percent weight loss is considered to be

[107]USEPA, 1989i.

acceptable[108]. The dual barrier caps that would be installed over the solidified residuals from the former disposal ponds under Remedial Alternative 9 would aid in preventing these effects on solidified material.

Thermal destruction of the organics and cyanide present in the CMSD is an irreversible process. This component of Remedial Alternative 9 would destroy organics forming simple inorganics such as carbon dioxide and water. These substances cannot be recombined to yield the constituents present in the CMSD.

6.10.5.4 Treatment Residuals

Treatment residuals resulting from the lime/ferrous salt precipitation component of Remedial Alternative 9 consist of dewatered sludge. Baker/TSA, Inc. estimated that full scale operation of a system to treat ground water pumped from the existing interceptor wells would yield approximately three tons per day of dewatered sludge (filter cake)[109]. Samples of the sludge from the pilot plant were collected and analyzed for reactive cyanide and EP Toxicity. This testing showed that the sludge was not a characteristic hazardous waste[110]. However, extensive pilot testing would need to be performed to determine the effectiveness of the treatment system and the character of the treatment residuals using ground water from wells placed closer to the source.

Post-treatment of the effluent from the lime/ferrous salt precipitation process by activated alumina adsorption would also generate treatment residuals. Regeneration of the activated

[108]USEPA, 1989i.

[109]Baker/TSA, Inc., 1990.

[110]Baker/TSA, Inc., 1990.

alumina adsorbers would be performed using concentrated caustic according to the following reaction[111]:

$$Al_2O_3 \cdot HF + 2NaOH \rightarrow Al_2O_3 \cdot NaOH + NaF + H_2O$$

This step is then followed by acidification using dilute hydrochloric acid as follows[112]:

$$Al_2O_3 \cdot NaOH + HCl \rightarrow Al_2O_3 + NaCl + H_2O$$

The residues resulting from activated alumina adsorption would consist of an aqueous solution of sodium chloride and sodium fluoride. Mass balance calculations indicate that approximately 88,000 gallons of these regeneration wastes would be produced per regeneration cycle. This equates to approximately 3,608,000 gallons per year.

Treatment residuals would also be associated with treatment of the collected seep water from the CMSD seeps. These residuals would include free-phase oil from the oil/water separator and spent activated carbon from the adsorber vessels. The amount of free-phase oil observed on the CMSD seeps during the RI was limited to a light sheen. Consequently, the amount of oil resulting from implementation of this alternative would be minimal. As discussed in Section 5, it was assumed that three containers of activated carbon would be expended quarterly. This equates to approximately 4,800 pounds per year (at 400 pounds per container).

Solidification of the pond solids and the sediments from Outfall 004 backwater area will also generate treatment residuals. The solidified material will increase from 25 to 75 percent by

[111]Singh & Clifford, 1981.

[112]Singh & Clifford, 1981.

volume, resulting in 530,000 to 740,000 CY of residuals (Table 6-13). As previously discussed in Section 6.5.5, the solidified pond solids will serve to bring the ponds to construction of the dual barrier caps over the former disposal ponds.

Treatment residuals would also be associated with thermal treatment of the solid material in the CMSD. Pre-processing of these materials would result in volume reduction through crushing, grinding, or shredding of these materials. Additionally, the volume of materials would be further reduced during thermal treatment by combustion of organic materials (timber, pallets, etc.) present in the CMSD. Based on visual observations during test pit excavations in the CMSD, the material to be treated consists largely of fire-brick, steel, some wood and other construction and demolition debris. Due to the nature of this material, it is estimated that only minimal volume reductions (i.e., 10 to 20 percent) will occur during thermal treatment.

6.10.6 Implementability

Remedial Alternative 9 is potentially implementable within site conditions. The implementability considerations associated with Remedial Alternative 9 are discussed in the following sections.

6.10.6.1 Constructability and Operability

This remedial alternative is operable within site conditions, but poses certain constructability problems related to the need to solidify the disposal pond solids prior to construction of a dual barrier cap. The Ormet site is an operating industrial facility with an established and well trained security and maintenance force. Accordingly, the Ormet site is well suited to ensure proper security, maintenance, and operation of the various components of this remedial alternative. There are no construction considerations for the ground-water extraction system, because the Ormet Ranney well is currently in operation and new interceptor wells could be installed closer to the FSPSA. From a physical standpoint, construction of the ground-water treatment system for the interceptor well water under this remedial alternative would not be hindered or adversely impacted by any of the existing conditions on-site. Construction of collection trenches for the CMSD and ballfield seeps would involve relatively shallow excavation depths and could be accomplished using commonly available heavy equipment. Treatability studies would be performed to determine the actual carbon usage for removing dissolved organics from the seeps.

Construction of dual barrier caps over the former disposal ponds utilizing a bentonite admixture as one of the barrier layers would require specialized mixing equipment and skilled personnel. The dual barrier caps would utilize synthetic membranes as the second barrier layer. This would also require specialized equipment for welding the seams of the membrane. This welding equipment would be utilized under the supervision of a qualified specialty installer.

Under Remedial Alternative 9, solidification of the solids from the former disposal ponds would be accomplished using backhoes, crawler-mounted injector-type mixers or a vertical auger mixer/injector[113]. Because of the size of Pond 5, clamshell or dragline equipment would probably be required to ensure an adequate reach for mixing the contents of Pond 5 with the solidification agents. Access for this type of equipment would be difficult along the berm of Pond 5 bordering the Ohio River due to the narrowness of the berm. To address the equipment access problem, Pond 5 could potentially be solidified by working progressively from the side adjacent to the former spent potliner storage area toward the river. This progressive approach would not prohibit the use of the equipment described above. The clamshell and dragline equipment required for this purpose is available. The lime and flyash reagents that would be

[113]Connor, 1990.

used for solidification under Remedial Alternative 9 are available in the Ohio River valley region. Treatability studies would be required to determine appropriate mixing ratio of the materials in the former disposal ponds with lime and fly ash for solidification. Prior to capping, the solidified material solids would be regraded to provide approximately a 4 percent slope for surface water run-off.

Commonly available earthmoving equipment, such as hydraulic excavators, would be used for the excavation of the soils from the former spent potliner storage area. Hydraulic excavators would be preferred for the excavation of the 4,000 CY of soil because precision of this equipment in excavating soil. Off-site transportation of the excavated soil would be achieved by truck. The former spent potliner storage area's proximity to the plant access road would make this means of transportation a viable option.

The sediments from the Outfall 004 backwater area could potentially be dredged in the following manner. A crawler-mounted clamshell could be maneuvered to the toe of the CMSD. This equipment would dredge the sediments from the Outfall 004 backwater area and place them on top of the CMSD for drying and solidification. Once situated on top of the CMSD, earthmoving equipment could be utilized to solidify the sediments with lime and flyash. Treatability studies would be performed to determine the proper mixing ratio of the sediments to the solidification reagents. After solidification, the sediments could be loaded into trucks, railcars, or barges for transport to the off-site landfill.

Thermal treatment of the material in the CMSD would be difficult to implement. The large amount of material handling, sorting, and pre-processing would require a number of temporary storage pads. Sufficient space is not available in the vicinity of the CMSD for these storage pads, as well as for the thermal processing equipment, ash storage pads, ancillary equipment, and support facilities. Due to the proximity of the CMSD to the river, operational controls would be required to prevent sloughing of materials into the river during excavation activities. An ultimate analysis would be required to determine the percentage of combustible products formed from incineration. A trial burn would also be required to determine the destruction and removal efficiency.

As discussed in Section 6.10.3.2, the current ground-water extraction system at the site has operated reliably since installation of the Ormet Ranney well and the existing interceptor wells. This has required periodic maintenance of the pumps and wells to ensure proper operation. It is anticipated that the operation of the interceptor wells installed closer to the source would require frequent maintenance of the pumps and well screen, due to the high concentrations of dissolved constituents and the tendency for the dissolved constituents to precipitate and cause scaling of the pumps and well screens.

Pilot studies have demonstrated that treatment of the ground water extracted by the existing interceptor wells requires careful process control[114]. Operational variability was found to be common during the pilot studies due to the complex chemistry involved in cyanide precipitation. Subsequent pilot studies demonstrated that the lime/ferrous salt precipitation process can be operated within the design/operating conditions. Operational variability of the entire system could be exacerbated by the chemical character of the ground water from the new interceptor wells. Under this remedial alternative, effluent from the precipitation process would be treated to adjust the pH into the 5 to 6 range required for optimum removal of fluoride by activated alumina adsorption. After passing through the activated alumina adsorbers, the pH of the effluent would be readjusted to be within the 6 to 9 range required under NPDES. The fluoride post-treatment system would also be equipped with additional tanks, piping, and controls for regeneration operations. All of this equipment would add to the overall complexity of the

[114]Baker/TSA, Inc., 1990.

treatment system. A significantly greater level of operator attention and control would be required for this system. Although treatability studies have been performed on ground water from the existing interceptor wells using the lime/ferrous salt precipitation process, the effectiveness of this treatment on ground-water from the new interceptor wells is not known. Additionally, the activated alumina post-treatment has not been tested. Therefore, extensive treatability studies would be needed prior to implementing GW-5.

There are no operability considerations associated with the single and dual barrier caps, and the steel sheet piling containment components of Remedial Alternative 9. However, periodic inspection of the containment structures would be required. Repairs could be performed if so indicated by these inspections.

6.10.6.2 Ability to Phase Into Operable Units

The component remedial measures that constitute Remedial Alternative 9 provide certain opportunities for phasing remediation of the Ormet site in operable units. For example, the following elements of Remedial Alternative 9 could be managed as operable units:

- ground-water extraction and treatment;
- seep collection and treatment;
- sediment dredging and disposal;
- treatment and containment of the CMSD; and
- solidification and containment measures.

Several of these component remedial measures must be implemented sequentially. For example, seep collection and treatment must precede containment of the CMSD because the trench drain would be constructed under the cap that would be placed over the CMSD treatment residuals. Similarly, solidification of the former disposal ponds must be performed prior to excavation of the CMSD.

6.10.6.3 Ability to Monitor Effectiveness

The short-term and long-term effectiveness associated with implementation of Remedial Alternative 9 would be effectively monitored through use of the existing network of ground-water monitoring wells. These wells could be used for periodic ground-water level measurements to confirm that the ground-water extraction system continues to contain the plume on-site. These wells would also be effective for periodic sampling to monitor plume distribution and constituent concentrations. Periodic ground-water quality data will also provide the best means of adjusting projections of the time required to achieve reductions in contaminant concentrations.

Cap inspections would be performed to monitor the integrity of the cap barrier. Inspections would include checking for differential settlement or soil subsidence, erosion, leachate outbreaks, surface water ponding and stressed vegetation.

The collection trenches for the CMSD and ballfield seeps would provide an opportunity to effectively monitor the flowrate of the seeps. Additionally, the discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to effectively monitor the chemical composition and concentrations of the discharges.

Additional remedial action could be instituted if monitoring indicates that such actions are needed. The CRDA would not pose a problem, since this area would be contained with no treatment. Additional remedial actions for ground water and the seeps would require modifications to the treatment systems. Changes of this nature would be difficult to implement.

The former spent potliner storage area, sediments, and CRDA would be excavated and disposed of off-site. The CMSD materials would be thermally treated prior to capping. The residual material from this treatment process would be in an altered state from the original material. This is similar for the former disposal pond solids, which will also be stabilized prior to capping. Thus, further remedial action on the treated media would be difficult.

6.10.6.4 Ability to Obtain Approvals

Certain approvals would be required for implementation of Remedial Alternative 9. Approvals would be required for construction of the ground-water treatment system for the interceptor well water that is included in this remedial alternative. Approval to construct this system would be in the form of a Permit-to-Install. Similarly, a PTI may be required for the CMSD seep collection and treatment system, and the ballfield seep collection system.

Approvals would also be required for discharges to surface-water under the NPDES program. The NPDES permit for the Ormet facility will govern discharges to surface-water under this remedial alternative.

Thermal treatment of the materials located in the CMSD will be performed entirely as an on-site response action. As such, thermal treatment will not require permitting according to the site response CERCLA Regulations. CERCLA Section 121(e) states that on-site response actions may proceed without obtaining permits or other administrative requirements. However, the thermal treatment component of this remedial alternative will require compliance with substantive requirements of action-specific ARARs for incinerators. For example, before commencing incineration, a trial burn will have to be conducted according to OAC 3745-50-62 in order to determine emissions and operating conditions for the incinerator.

Pursuant to the terms of an easement granted to the United States, approvals may be necessary from the U.S. Army Corps of Engineers (USACOE) prior to any bank improvements involving any dredge or fill activities along the edge of the Ohio River and the Outfall 004 backwater area.

6.10.6.5 Availability of Off-Site Services and Capacity

Under Remedial Alternative 9, off-site transportation and disposal services would be required for some of the treatment residuals identified in Section 6.10.5.4. Under this remedial alternative, the sludge resulting from the lime/ferrous salt precipitation process would be handled by off-site landfilling. Spent regenerants from the activated alumina treatment system would be treated off-site. The required transportation and disposal services for these residuals exist within USEPA Region V[115]. Adequate disposal capacity is commercially available for these materials.

Free-phase oil, if any, resulting from treatment of the CMSD seeps would be handled by off-site facilities. Due to the potential presence of PCBs in the oil, it has been assumed that the oil would be treated by incineration. The required transportation and disposal services for the oil exist within USEPA Region V[116]. Adequate disposal capacity is commercially available.

Remedial Alternative 9 includes excavation of the carbonaceous material from the carbon run-off and deposition area and partial excavation of approximately 4,000 CY of soil from the former spent potliner storage area. These materials would be addressed by off-site landfill disposal. Additionally, this remedial alternative would involve dredging of approximately 2,000

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[115]USEPA, et. al., 1990.

[116]USEPA, et. al., 1990.

CY of sediments from the Outfall 004 backwater area. These sediments would be addressed by solidification and off-site landfilling. The required transportation and disposal services for all of these materials are available within USEPA Region V. Adequate disposal capacity is available for these materials.

Spent activated carbon resulting from treatment of the CMSD seeps would also be handled by off-site facilities under Remedial Alternative 9. Due to the relatively small quantity of spent carbon, regeneration is not feasible for this material. Commercial suppliers of activated carbon were contacted regarding the availability of regeneration services for carbon that would contain PCBs. These services do not exist. Consequently, the spent activated carbon would be managed by off-site landfill disposal or thermal treatment. The required transportation and disposal services are available. Adequate disposal capacity is also available for the spent activated carbon.

6.10.6.6 Availability of Equipment and Specialists

Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components of this remedial alternative. However, trained operators would be required for the ground-water treatment equipment, as well as the CMSD seep treatment system.

Installation of steel sheet piling as an operational control during dredging of the Outfall 004 backwater area would require specialized equipment. Pile driving equipment and the required personnel are available for both land-driven and barge-driven installations.

Specialized equipment and skilled workers would be required for solidification of the pond solids and the sediments. This service is commercially available.

Commonly available earthmoving equipment would be required for the partial excavation of soils from the former spent potliner storage area; therefore, no specialized equipment or skilled workers would be required for these activities.

Specialized equipment and skilled workers would be required for installation of the single and dual barrier caps under this remedial alternative. However, the required materials and services are available through a variety of commercial sources.

Specialized equipment would be required for thermal treatment of the materials in the CMSD. The thermal processing equipment would include the rotary kiln incinerator, feed conveyor, air pollution control equipment, ash handling equipment, fuel storage, and control room. Systems of this type are available through various sources. Skilled operators would be required for proper operation of the thermal treatment system.

6.10.7 Cost

The capital and O&M costs that would be incurred through implementation of Remedial Alternative 9 are presented in this Section.

6.10.7.1 Capital Cost

The capital costs for Remedial Alternative 9 are summarized in Table 6-44. Details regarding the capital costs for various components of this remedial alternative are provided in the following tables:

- Table 6-3: Estimated Capital Costs for Sitewide Institutional Controls

TABLE 6-44. Summary of Capital Costs for Sitewide Remedial Alternative 9.

COST ELEMENT	REFERENCE TABLE	ESTIMATED COST
1. Sitewide Institutional Controls	6-3	$81,008
2. Seep Collection and Treatment System	6-7	$69,550
3. Solidification	6-20	$7,924,380
4. Thermal Treatment	6-29	$68,532,360
5. Future Containment of CMSD {1}	6-30	$436,000
6. Ground-water Treatment System	6-45	$3,202,580
7. Containment	6-46	$4,185,198
8. Excavation and Off-Site Disposal	6-47	$4,177,623
9. New Interceptor Wells	6-50	$93,497
	SUBTOTAL	$88,702,196
Engineering/Design (10%)		$8,870,220
Installation/Shakedown (5%)		$3,590,225
	SUBTOTAL	$101,162,640
Contingency (20%)		$20,232,528
	SUBTOTAL	$121,395,168
Ground-Water Treatment O&M (years 1-10) {2}	6-10	$13,008,597
	TOTAL {1}	$134,403,765
	ROUND	$134,000,000

{1} Present worth discounted to year 10.
{2} Reflects 10-year present worth at 10%.

- Table 6-6: Unit Costs Utilized for Estimating Containment Costs
- Table 6-7: Estimated Capital Costs for Seep Collection and Treatment System
- Table 6-20: Estimated Capital Cost for Solidification Under Remedial Measures FDP-3 and FDP-7
- Table 6-28: Estimated Capital Costs for Thermal Treatment Under Remedial Measure CMSD-7
- Table 6-30: Present Worth of Containment for CMSD Following Thermal Treatment Under Remedial Measure CMSD-7
- Table 6-45: Estimated Capital Costs for Ground-Water Treatment System Under Remedial Measure GW-5
- Table 6-46: Estimated Capital Costs for Containment Under Remedial Alternative 9
- Table 6-47: Estimated Capital Costs for Excavation and Off-Site Disposal Under Remedial Alternative 9

6.10.7.2 Operating and Maintenance Costs

The operating and maintenance costs that would be incurred through implementation of Remedial Alternative 9 are summarized in Table 6-48. The O&M costs for collection and treatment of the CMSD seeps are presented in Table 6-11. O&M costs associated with the

TABLE 6-45. Capital Costs for Ground-Water Treatment System Under Remedial Measure GW-5{1}.

COST ELEMENT	ESTIMATED QUANTITY	UNIT	UNIT COST	ESTIMATED COST
1. TREATABILITY TEST	1	LS	$500,000	$500,000
2. EQUIPMENT				
Reactor Tank	1	each	$20,300	$20,300
Clarifier	1	each	$155,000	$155,000
Lime Slurry System	1	each	$84,200	$84,200
Ferrous Sulfate System	1	each	$79,600	$79,600
Polyelectrolyte System	1	each	$5,200	$5,200
Sludge Thickner	1	each	$42,000	$42,000
Sulfuric Acid Tank	1	each	$14,700	$14,700
Sludge Dewatering	1	each	$139,900	$139,900
Mixers (8)	1	LS	$80,700	$80,700
Pumps and Blowers (23	1	LS	$80,700	$80,700
Diatomaceous Filter	1	each	$45,000	$45,000
Equalization Tank	1	each	$221,300	$221,300
Sodium Hydroxide Tank	1	each	$13,000	$13,000
Hydrochloric Acid Tank	1	each	$15,500	$15,500
Make-up Tanks	2	each	$3,000	$6,000
Regenerant Waste Tank	1	each	$275,000	$275,000
Alumina Vessels	2	each	$41,000	$82,000
			SUBTOTAL	$1,860,100
3. BUILDINGS				
Control Building	1	each	$242,300	$242,300
4. CONCRETE				
Containment Pad	1	LS	$217,800	$217,800
Foundations	1	LS	$34,300	$34,300
			SUBTOTAL	$252,100
5. INSTALLATION				
Instrumentation	1	LS	$243,960	$243,960
Electrical	1	LS	$250,460	$250,460
Mechanical (Piping)	1	LS	$195,660	$195,660
Site Preparation	1	LS	$158,000	$158,000
			SUBTOTAL	$848,080
			TOTAL {2}	$3,202,580
			ROUND	$3,200,000

{1} Baker/TSA, Inc., August 9, 1990. Costs for these items have not been indexed.

{2} Indirect capital costs and contingencies for the ground-water treatment system are included in the summaries for the overall remedial alternatives.

TABLE 6-46. Estimated Capital Costs for Containment Under Remedial Alternative 9.

COST ELEMENT	ESTIMATED QUANTITY	UNIT	UNIT COST	ESTIMATED COST
1. DUAL BARRIER CAPS (FDPs)				
Regrading	74,500	CY	$8.23	$613,135
Membrane (40 mil HDPE)	818,000	SF	$0.50	$409,000
Geonet	818,000	SF	$0.26	$212,680
Geotextile (10 oz.)	818,000	SF	$0.18	$147,240
Clay (Transport)	60,600	CY	$19.00	$1,151,400
Clay (Placement)	60,600	CY	$2.08	$126,048
Hydroseed	818,000	SF	$0.04	$32,720
			SUBTOTAL	$2,692,223
2. SINGLE BARRIER CAP (FSPSA)				
Fill (Transport)	16,300	CY	$11.36	$185,168
Fill (Placement)	22,500	CY	$2.08	$46,800
Membrane (40 mil HDPE)	610,000	SF	$0.50	$305,000
Geonet	610,000	SF	$0.26	$158,600
Geotextile (10 oz.)	1,220,000	SF	$0.18	$219,600
Borrow (Transport)	30,000	CY	$5.00	$150,000
Borrow (Placement)	30,000	CY	$9.82	$294,600
Hydroseed	610,000	SF	$0.04	$24,400
			SUBTOTAL	$1,384,168
3. CONSOLIDATE CRDA IN CMSD				
Clearing/Grubbing	4.5	acre	$2,800	$12,600
Excavation	5,700	CY	$6.15	$35,055
Borrow (Transport)	3,600	CY	$5.00	$18,000
Borrow (Placement)	3,600	CY	$9.82	$35,352
Hydroseeding	195,000	SF	$0.04	$7,800
			SUBTOTAL	$108,807
			TOTAL {1}	$4,185,198
			ROUND	$4,200,000

{1} Indirect capital cost and contingencies for the containment systems are included in the summary for overall remedial alternatives.

TABLE 6-47. Estimated Capital Costs for Excavation and Off-Site Disposal Under Remedial Alternative 9.

COST ELEMENT	ESTIMATED QUANTITY	UNIT	UNIT COST	ESTIMATED COST
1. FSPSA				
Excavation	4025	CY	$6.15	$24,754
Transportation	210	load	$740	$155,400
Disposal	4025	CY	$230	$925,750
Fill (Transport)	4025	CY	$11.36	$45,724
Fill (Placement)	4025	CY	$2.08	$8,372
			SUBTOTAL	$1,160,000
2. CRDA				
Excavation	5,700	CY	$6.15	$35,055
Transportation	285	load	$740	$210,900
Disposal	5,700	ton	$230	$1,311,000
Fill (Transport)	5,700	CY	$11.36	$64,752
Fill (Placement)	5,700	CY	$2.08	$11,856
Hydroseeding	195,000	SF	$0.04	$7,800
			SUBTOTAL	$1,641,363
3. SEDIMENTS				
Dredging	2,000	CY	$33	$66,000
Solidification	2,000	CY	$20.33	$40,660
Silt Curtains	1	LS	$40,000	$40,000
Transportation	220	load	$740	$162,800
Disposal	4,400	ton	$230	$1,012,000
Fill (Transport)	4,000	CY	$11.36	$45,440
Fill (Placement)	4,000	CY	$2.08	$8,320
Hydroseed	26,000	SF	$0.04	$1,040
			SUBTOTAL	$1,376,260
			TOTAL {1}	$4,177,623
			ROUND	$4,200,000

{1} Indirect capital costs and contingencies for excavation and off-site disposal are included in the summary for overall remedial alternatives.

TABLE 6-48. Summary of O&M Costs for Sitewide Remedial Alternative 9.

COST ELEMENT	REFERENCE TABLE	ESTIMATED ANNUAL COST
1. Sitewide Institutional Controls	6-9	$28,325
2. Seep Collection and Treatment System	6-11	$19,786
3. Containment	6-12	$88,000
4. Ground-water Treatment	6-49	$2,117,078
	SUBTOTAL	$2,253,189
Administration (12%)		$270,383
	SUBTOTAL	$2,523,572
Contingency (20%)		$504,714
	TOTAL	**$3,028,286**
	ROUND	**$3,000,000**

TOTAL PRESENT WORTH (10% PRESENT WORTH FACTOR) 30 Year Operation with Ground-Water Treatment O&M for Years 1-10 Included in Capital Cost of Alternative.	$11,000,000

containment components of Remedial Alternative 9 are presented in Table 6-12. The O&M costs for thermal treatment of CMSD materials are summarized in Table 6-32. The O&M costs for the ground-water extraction and treatment components of this remedial alternative are summarized in Table 6-49.

6.10.7.3 Present Worth

The present worth of Remedial Alternative 9 was calculated to be $145,000,000. This value was calculated in accordance with USEPA guidance[117] utilizing an operating period of 30 years and a discount rate of 10 percent.

6.11 Remedial Alternative 10

Remedial Alternative 10 constitutes a containment alternative for the Ormet site. This Alternative was assembled by combining the following remedial measures:

- GW-5: Pumping of the Ranney well and New Interceptor Wells, Treatment of the New Interceptor Well Water by Ferrous Salt Precipitation, Clarification, and Activated Alumina Post-Treatment and Discharge to the Ohio River;
- SP-4: Collection of Ballfield and CMSD Seeps Using Trench Drains, Treatment of CMSD Seeps by Oil/Water Separation and/or Carbon Adsorption;
- FSPSA-10: Containment by Single Barrier Clay Cap;
- FDP-10: Containment by Single Barrier Clay Cap;

[117]USEPA, 1987.

TABLE 6-49. Estimated Annual O&M Costs for Ground-Water Treatment Under Remedial Measure GW-5.

COST ELEMENT	ESTIMATED ANNUAL QUANTITY	UNIT	UNIT COST	ANNUAL TOTAL COST
1. CHEMICALS				
Ferrous Sulfate Heptahydrate	314	ton	$183	$57,462
Hydrated Lime	252	ton	$251	$63,252
Sulfuric Acid	523	ton	$96	$50,208
Polyelectrolyte	2,215	lb	$27	$59,805
Diatomaceous Earth	219,000	lb	$0.21	$45,990
Activated Alumina	15	ton	$1,180	$17,700
Sodium Hydroxide	900	ton	$370	$333,000
Hydrochloric Acid	1070	ton	$75	$80,250
			SUBTOTAL	$707,667
2. UTILITIES				
Electricity	751,900	Kwh	$0.06	$45,114
Electricity (Ormet Ranney Well)	980,250	Kwh	$0.06	$58,815
Electricity (Interceptor Wells)	163,400	Kwh	$0.06	$9,804
			SUBTOTAL	$113,733
3. RESIDUALS DISPOSAL				
Sludge	1,107	ton	$280	$309,960
Alumina Regenerant	3,912,920	gal	$0.21	$821,713
			SUBTOTAL	$1,131,673
4. LABOR				
Treatment Plant Operation	3,616	man-hr	$25	$90,400
Ormet Ranney Well	1	LS	$3,500	$3,500
Interceptor Wells	1	LS	$2,100	$2,100
			SUBTOTAL	$96,000
5. MAINTENANCE				
Process Equipment (5% TEC{1})				$68,005
			TOTAL {2}	$2,117,078
			ROUND	$2,100,000

{1} Based on Total Equipment Costs ($1,360,100) per Table 6-45.

{2} Indirect costs and contingencies for O&M of the ground-water treatment system under remedial measure GW-5 are included in the O&M summary for Remedial Alternative 7.

- CMSD-8: Recontouring and Containment by Single Barrier Clay Cap;
- CRDA-3: Excavation, Consolidation and Containment by Single Barrier Clay Cap; and
- SED-10: Dredging of Backwater Area and River Sediments, Treatment by Solidification, Consolidation with CMSD, and Containment.

Details regarding the component remedial measures that were assembled to form this remedial alternative are discussed in Section 5.11.

6.11.1 Compliance with ARARs

The ability of Remedial Alternative 10 to comply with chemical-, location-, and action-specific ARARs established for the Ormet site is evaluated in this Section.

6.11.1.1 Chemical-Specific ARARS

The ability of this remedial alternative to attain chemical-specific ARARs for surface-water using BAT to treat ground water pumped by the new interceptor wells located closer to the source, prior to discharge to the Ohio River is uncertain. Effluent cyanide and fluoride concentration reductions were achieved during pilot-scale studies of the lime/ferrous salt precipitation treatment system using ground water pumped from the existing interceptor wells. Extensive pilot-scale testing would be required to evaluate the effectiveness of the treatment process using ground water pumped from wells closer to the source. Post-treatment by activated alumina adsorption could reduce fluoride concentrations further, although the extent of these reductions is not known.

Discharge of the treated CMSD seep water would also attain chemical-specific ARARs for surface water discharge. The parameters addressed in the NPDES effluent limits currently proposed for the Ormet site would not be exceeded by the CMSD seeps. This is evidenced by the seep quality data obtained during the RI. In the event that the effluent from the seep collection and treatment systems exceeds the NPDES discharge limits, these residuals could undergo further treatment prior to discharge if necessary.

Containment of the former spent potliner storage area, the former disposal ponds, and the CMSD, coupled with ground-water extraction by the existing interceptor wells should ultimately achieve chemical-specific ARARs for aquifer quality (i.e., MCLs and non-zero MCLGs).

Remedial Alternative 10 would comply with ARARs for the carbonaceous material in the carbon run-off and deposition area. Under this remedial alternative, these materials would be excavated and consolidated within the CMSD prior to capping of the CMSD. The carbonaceous material in the CRDA is not itself a listed hazardous waste. The carbonaceous material, which consists primarily of spent anode material (calcined coke), was historically transported into the CRDA by storm water run-on during heavy rainfall. Prior to removal and consolidation in the CMSD, the CRDA material would be appropriately characterized to determine its status relative to the LDRs.

6.11.1.2 Location-Specific ARARs

Remedial Alternative 10 would comply with federal and state location-specific ARARs regarding location criteria for solid waste landfills. As identified in Table 1-1, these criteria specify locations in which solid waste landfills are not to be cited, such as floodplains. This ARAR does not require the removal of existing landfills. The 100-year floodplain requirement set forth in OAC 3745-27-07 (A,B) prospectively prohibits the deposition of solid wastes in a floodplain. The floodplain requirement is not retrospective, and USEPA guidance recognizes that it is not appropriate to remove large existing landfills from the floodplain[118]. The side slopes of the CMSD bordering the Ohio River and the Outfall 004 backwater area are currently situated within the 100-year floodplain of the Ohio River. The 100-year flood elevation is defined by the Federal Emergency Management Agency (FEMA) as the elevation having a 1% chance of being equaled or exceeded in any given year.

The Floodplain Protection Policies (40 CFR6, Appendix A, and the Fish & Wildlife Coordination Act, 16 USC 661 et seq) are TBCs for the Ormet site. The substantive requirements of these TBCs are potentially relevant to any activities undertaken by the Federal government.

Under this remedial alternative, the side slopes of the CMSD would be largely removed from the 100-year floodplain by regrading. These actions would be protective of human health and the environment, however a small portion of the material in the CMSD would remain below the 100-year floodplain elevation of 637.5 feet. This 2.5 foot high portion of the CMSD sideslopes would be protected from erosion damage by placement of a riprap barrier along the toe of the CMSD (see Figure 5-9).

[118]USEPA, 1988d.

6.11.1.3 Action-Specific ARARs

Operation of the Ormet Ranney well and new interceptor wells would be subject to certain action-specific ARARs under Remedial Alternative 10. Specific maintenance requirements for ground-water casings, pumps, and wells (in general) are set forth in OAC 3745-9-09. Remedial Alternative 10 would comply with these requirements. Treatment of the new interceptor well water under Remedial Alternative 10 would also be subject to action-specific ARARs. This remedial alternative would comply with the substantive requirements of any Permit-to-Install, as well as operational, maintenance, and monitoring requirements under a NPDES permit.

Off-site landfilling of the ground-water treatment residuals would be subject to action-specific ARARs regarding waste characterization. Remedial Alternative 10 would comply with these requirements. Depending on the outcome of the waste characterization, Remedial Alternative 10 may be subject to various transportation and disposal requirements, including the LDRs.

The single barrier clay caps that would be constructed over the former disposal ponds, the former spent potliner storage area, and the CMSD would attain the State of Ohio Solid Waste ARARs.

Capping the CMSD under this remedial alternative would not necessitate an explosive gas monitoring plan because construction materials are generally not putrescible. Wooden scrap that was emplaced in the CMSD is putrescible, however, visual observations during test pit excavation confirmed that this material only makes up a small portion of the CMSD. Furthermore, wooden scrap would not be likely to putrefy at a rate sufficient to generate explosive gases within the CMSD. If the wooden scrap in the CMSD was found to be putrescible, the accumulation of gas under the impermeable barrier could be controlled using passive gas vents. The need for gas controls would be evaluated during remedial design. Air monitoring performed during test pit excavation in the CMSD did not detect the presence of explosive gases.

Remedial measures for the sediments in the Outfall 004 backwater area and the Ohio River immediately downstream of the backwater area under this alternative would attain action-specific ARARs for PCBs. The cleanup goals for PCBs and PAHs that are provided in Appendix F would be attained by the dredging of the backwater area and river sediments. Under this alternative, sediments containing greater than 1.1 mg/kg PCBs and greater than 370 mg/kg total PAHs would be excavated from the backwater area and the portion of the river immediately adjacent to the backwater area. The excavated materials would be treated and contained in the CMSD under a single barrier clay cap. If concentrations of PCBs in the dredged sediments exceed 50 mg/kg, a TSCA-compliant cell may need to be constructed within the CMSD. Containment of the excavated materials in this manner would attain substantive requirements for chemical waste landfilling under TSCA. Following removal, the excavated area would be sampled to confirm that the cleanup goals for PCBs and PAHs under this alternative have been achieved.

6.11.2 Overall Protection

The protectiveness of Remedial Alternative 10 for human health and the environment would be very similar to Remedial Alternative 3, except for sediments in the Outfall 004 backwater area and the river. In this area, rerouting of the outfall stream, coupled with the dredging of sediments would result in temporary disruption of benthic habitat. Environmental goals would be met by resedimentation and the associated restoration of benthic habitat.

The potential human health exposure pathways include:

- inhalation of airborne dusts from the former spent potliner storage area and the former disposal ponds;
- ingestion of contaminated media from all areas of concern;
- direct contact with contaminated media from all areas of concern;

These exposure pathways would be effectively addressed under Remedial Alternative 10 for all areas.

6.11.3 Short-Term Effectiveness

This remedial alternative would be protective of human health and the environment in the short-term. The short-term effectiveness associated with implementation of Remedial Alternative 10 is described in the following sections.

6.11.3.1 Time Until Protection is Achieved

The protection associated with Remedial Alternative 10 could be achievable within two to four years following remedy selection. Once the containment structures under this remedial alternative are constructed, the remedial action objectives would be achieved by blocking direct exposure pathways of inhalation and ingestion. Containment of the ground-water plume would be achieved immediately because pumping of the Ormet Ranney well represents current conditions. Effective treatment of the ground-water extracted by the existing and new interceptor wells may be achievable, pending treatability testing using ground-water pumped from the new interceptor wells, final design of the treatment system, and construction and shakedown of the treatment plant. The timeframe for this component of Remedial Alternative 10 is estimated to be 2 to 3 years.

Some of the elements of this remedial alternative could potentially achieve protection within a very short timeframe. Collection and treatment of the CMSD seeps falls within this category. In consideration of the relative simplicity of the treatment system for the CMSD seeps, design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Furthermore it is possible that the seeps would eventually disappear with the capping of the CMSD.

Coordination of dredging activities with the Army Corps of Engineers and compliance with the substantive permit requirements under this remedial alternative may extend the timeframe for achieving protection. The extent of this increase in the time required for implementation is not known, but may be on the order of one to three years.

Remedial Alternative 10 involves clay caps over several areas. These caps could be constructed within 2 to 4 years. The estimated construction time for capping was developed assuming sequential capping of the former spent potliner storage area, the former disposal ponds, the CMSD, and removal of the Outfall 004 backwater area and river sediments.

6.11.3.2 Short-Term Reliability

The short-term reliability of Remedial Alternative 10 is unknown, due to the uncertainty regarding the ability to treat ground water from interceptor wells closer to the source. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well (installed in 1958) and the new interceptor wells. The Ranney well has operated reliably since its installation and would continue to do so under this remedial alternative. The Ormet Ranney well is equipped with three 150 HP pumps and the interceptor wells are each equipped with a 25 HP submersible pump. Under normal operations, one of the pumps in the Ormet Ranney well is operated. Therefore, the ground-water containment system currently has in-line redundancy to ensure reliable, continuous operation.

Containment of the former spent potliner storage area, the former disposal ponds, the CMSD, and the Outfall 004 backwater area sediments would not be performed in the short-term. As discussed in Section 6.11.3.1, approximately 2 to 4 years will be required for containment of these areas. Therefore, containment of these areas would be initiated in the mid-term, and would continue over the long-term. The reliability of this component of Remedial Alternative 3 is addressed in Section 6.11.4.3.

During dredging, the sediments would be contained using silt curtains and sheet piling. The currents of the Ohio River during high flow periods may not be suitable for deployment of silt curtains. Literature indicates that silt curtains work best when the current as less than one knot. Since containment would only be needed near the bank of the Ohio River and the site is situated on the inside of a meander, river current in the vicinity of the Ormet site may not exceed one knot. Silt curtains may therefore be effective in controlling transport of the sediments. Both of these operational controls are effective in the short-term. Sediment captured by the barriers would be removed and disposed of properly.

6.11.3.3 Community Protection

Implementation of this remedial alternative would not adversely impact the health or safety of the community during the construction period. The containment components of Remedial Alternative 10 will require regrading of the CMSD, former spent potliner storage area, and the former disposal ponds. Additionally, the sediments in the Outfall 004 backwater area and a small portion of the Ohio River would be dredged and the carbonaceous material in the CRDA would be excavated and placed under the cap in the CMSD. These earthmoving activities could potentially result in airborne emissions of dust and other substances. However, as discussed in Section 4, these emissions would be effectively controlled through application of dust suppressants such as water, anhydrous calcium chloride, or foam.

Under this remedial alternative, ground-water extracted by the existing interceptor wells would continue to be discharged to the Ohio River via Outfall 004, pending completion of treatability testing to evaluate the feasibility of treating ground water from the new interceptor wells. These activities would not adversely impact the community over the short-term because river water in this area is not used for drinking purposes and recreational uses in the vicinity of the site are minimal. Additionally, bioassay testing of the Outfall 004 water, which includes ground-water extracted by the interceptor wells demonstrated that this water is not acutely toxic to aquatic organisms.

There is no possibility that implementation of this alternative would generate toxic gases. Ground-water treatment would be performed at alkaline pH, therefore the generation of HCN gas is not possible. None of the other treatment or containment components of this alternative would result in the possible generation of toxic reaction by-products.

6.11.3.4 Worker Protection

Implementation of Remedial Alternative 10 would be protective of workers involved in remedial construction activities. Workers associated with remedial construction activities under this alternative would require training and medical monitoring in accordance with 29 CFR 1910.120. Additionally, these workers would be required to utilize protective clothing and respiratory equipment as specified in a site-specific health and safety plan. Operational controls (i.e., work zones, decontamination facilities, air monitoring, etc.) would be established to further protect workers during the construction period.

Dust suppressants would be used during the excavation of the CRDA to restrict fugitive dust emissions. Dredging of the Outfall 004 backwater and river sediments is not expected to generate significant dust unless the sediments are allowed to dry at which point dust suppressants may also be used on the sediments. Given the use of dust suppressants, the amount of dust possibly generated cannot be estimated, but inhalation exposure during the period of excavation and transfer to the CMSD is expected to be minimal. Appropriate protective equipment would be utilized during the period of excavation and material handling to provide additional protection of the workers.

6.11.3.5 Environmental Impacts

Construction of the various components of this remedial alternative will result in short-term environmental impacts at the site, which may include the following:

- Disruption of natural drainage patterns;
- Generation of dust and noise;
- Increased sediment runoff;

- Installation of temporary roads and utilities;
- Resuspension of sediments; and
- Construction of temporary staging and vehicle maintenance areas.

These impacts will be minimized through the use of standard construction and engineering practices, including the use of runon-runoff controls, silt fences and sedimentation basins, dust suppresants, silt curtains, and general good housekeeping practices. The actual measures to be taken to address potential environmental impacts during remedy construction will be determined during remedial design. The costs associated with these measures have been factored into the estimated cost for this remedial alternative.

6.11.4 Long-Term Effectiveness

This remedial alternative would also be protective of human health and the environment over the long-term. The long-term effectiveness that would result from implementation of Remedial Alternative 10 is evaluated in the following sections.

Ground-water remediation and aquifer restoration at the Ormet site will be a long-term program, probably in terms of decades. This remedial alternative includes ground-water remedial measure GW-5, which consists of pumping of the Ormet Ranney well and new interceptor wells to control and recover the plume, followed by treatment of the ground water extracted by the interceptor wells using BAT prior to discharge to the Ohio River. Although at this point in time, an exact prediction of the duration of ground-water remediation is not possible, estimates of the timeframe required to accomplish aquifer restoration can be refined as the remedial program progresses. Over the past 9 years of monitoring, the available data indicate that there has already been an improvement in the quality of ground water pumped from the existing interceptor well system (see Appendix A). To facilitate the comparison of alternatives presented in this FS, the time that may be required to reduce concentrations of total cyanide in ground-water pumped by the new interceptor wells to 0.1 mg/L has been roughly projected to be 36 years under current site conditions. A more detailed discussion of the calculations, data, and assumptions used to project reductions in cyanide concentrations is provided in Appendix K. Installation of the completed clay caps as source control measures under Remedial Alternative 10 is expected to decrease this time frame, as infiltration of precipitation through the unsaturated soils would be virtually eliminated. However, due to the fluctuations in the water table elevation over time and the consequent contact of ground water with unflushed deposits, the extent to which aquifer restoration times may be reduced by the caps is uncertain.

This alternative would be effective in reducing the infiltration of precipitation through the soils of the former spent potliner storage area, the solids in the former disposal ponds, and the wastes in the CMSD. Regrading of the site and construction of the single barrier clay caps would promote run-off and evapotranspiration. Infiltration modelling was performed for the single barrier clay caps (see Appendices I & J). For the FSPSA, and CMSD, regrading and construction of the single barrier clay cap would reduce infiltration by approximately 97.2 percent over existing conditions. Based on these results, leachate generation in these areas would be virtually eliminated.

6.11.4.1 Reduction of Assumed Existing Risks

Similar to Remedial Alternative 3, implementation of Remedial Alternative 10 would reduce the existing human health and environmental risks (as assumed in the Baseline Risk Assessment) by addressing the potential for exposure. Exposure to the constituents detected in the soils would be eliminated by the construction of the single barrier cap. Direct contact with the soils beneath the cap would be precluded and emission of fugitive dust would not occur.

There would be no exposure to the impacted soils beneath the single barrier cap, therefore, the risks would be zero.

Ground-water risks were not identified as an existing risk at the site. Pumping of the interceptor wells and treatment of the captured ground-water would continue to prevent current exposure to the ground water beneath the site. This system is equally effective in addressing the constituents detected in the ground water from past releases from the site, as well as any additional leaching that might occur through the single barrier cap.

Collection of the seep water in the trenches and discharge to the Ohio River following treatment, if necessary, to acceptable discharge levels would preclude exposure to the seep waters by trespassers or terrestrial animals. The exposure pathways for the seep waters would be eliminated, therefore, the risks associated with the seep waters would be zero.

Dredging of the Outfall 004 backwater area and river sediments would prevent direct exposure to constituents in sediments and prevent future releases from the backwater area to the river. The human exposure pathways to the sediments would be eliminated, therefore, the risks would be zero. Exposure of fish in the Ohio River from these sediments would also be eliminated. Therefore, the risk to humans associated with ingestion of fish that may have bioaccumulated constituents from the Ormet site would be zero.

Relatively rapid sedimentation would be expected to occur, because the site is located on the inside of a meander in the river and the river currents adjacent to the site would be less than elsewhere in the river channel. Furthermore, the site is situated upstream of the Hannibal Lock and Dam and as such, the large quantity of water pooled behind the dam would promote siltation. Therefore, the risks for a trespasser are expected to decrease over time as the sediments are covered by background river sediments.

6.11.4.2 Magnitude of Future Risks

Under Remedial Alternative 10, constituents in the alluvial ground water would be collected and treated similar to Remedial Alternative 9. Future hypothetical exposure of plant workers, maintenance workers, and residents to the ground water by ingestion would be precluded by the containment and treatment of the ground water extracted by the interceptor wells, and by the establishment of a deed restriction on the property that would preclude use of contaminated ground water as a source of potable water.

Trench drains would effectively collect seeps at the ballfield and the CMSD. Future exposure of child or adult residents to the seep water would be eliminated by these actions.

Pumping and treatment of the impacted ground water, collection of the seep water in trench drains, combined with the deed restrictions on future land use would effectively eliminate the potential for future exposure of plant workers, maintenance workers, and residents by ingestion of the constituents in the ground water. This would include eliminating the potential for exposure to any constituents that might still leach from the underlying media after the single barrier cap is installed. Therefore, in the absence of an exposure pathway, the potential future risks associated with the ground water are zero.

Single barrier clay caps on the former spent potliner storage area, the former disposal ponds, and the CMSD (with the consolidated carbonaceous material from the carbon run-off and deposition area and the dredged sediments from the Outfall 004 backwater area and river) would prevent the emission of fugitive dust and eliminate direct contact exposure to the impacted soils. The single barrier caps over these areas would preclude future exposure by inhalation of the constituents and would thereby eliminate future risks to humans or terrestrial wildlife. With the exception of deep burrowing animals, the single barrier clay caps would preclude exposure of most terrestrial organisms. It is possible that the affected media may also act as a deterrent to burrowing animal activity. The single barrier cap forms a physical barrier that would preclude phytotoxicity to all but the deepest rooting plants such as trees. An aspect of the maintenance of the single barrier cap would include control of burrowing animals and removal of seedling trees that might take root at the site. Infiltration through the single barrier cap could mobilize some of the constituents in the subsurface soils, however, as discussed in the preceding paragraph, these constituents would pose zero risks to humans or wildlife.

Because the 004 Backwater area is an embayment of the Ohio River, relocation of 004 outfall stream prior to sediment removal would not eliminate benthic habitat. Because the backwater area is an embayment, resedimentation and the associated restoration of benthic habitat would occur relatively rapidly. The overall effect of these actions would be that exposure to constituents in the backwater area would be eliminated. Food chain exposures associated with the Outfall 004 backwater area would be essentially eliminated. Therefore, the potential for direct exposure and aquatic food chain exposure would also be eliminated.

In summary, the remedial measures that comprise Remedial Alternative 10 would eliminate or significantly reduce the potential for exposure, and the potential future risks to humans and the environment would be reduced to acceptable levels.

6.11.4.3 Long-Term Reliability

Remedial Alternative 10 would be reliable over the long-term. As discussed in Section 6.11.3.2, containment of the ground-water plume through continued pumping of the Ormet Ranney well has performed reliably since its installation. In consideration of the in-line redundancy of ground-water containment utilizing the Ormet Ranney wells and the interceptor wells, the reliability of this system over the long-term is expected to be good.

Long-term reliability of single barrier clay caps has been proven, dependent upon adequate post-closure maintenance. The reliable life expectancy of a standard (i.e., single barrier) landfill cap with normal maintenance is approximately 50 to 100 years (Versar, Inc., 1991). Caps comprised of compacted clay can achieve very low permeabilities if they are well compacted and the moisture content of the clay is maintained in an optimal range. Clay caps are susceptible to dessication cracking, freeze/thaw damage, chemical effects, root penetration, and settlement. Installation of an adequate soil cover over the clay barrier layer can reduce the effects of freeze/thaw and drying. Proper QA/QC during cap installation and routine inspections during the life of the cap can also reduce the potential for damage to the cap. Standard engineering practice of installing geotextile fabric between the vegetated layer and drainage layer, coupled with vegetating the cover with grasses that do not have deep roots, will aid in preventing root penetration. Burrowing animals that currently live on-site would be controlled (OAC 3745-27-11 (G)(4)). The geotextile fabric and geonet will also aid in preventing animals from burrowing into the cap. A well-maintained vegetative cover, periodic inspections and limited site access will ensure reliable long-term performance of the single barrier caps. Synthetic membranes exhibit a high degree of resistance to chemical contact and are capable of elongating up to 500 percent (National Sanitation Foundation Standard Number 54). Unless atypical settlement or depressions develop, the integrity of a synthetic membrane cap will not be compromised by settlement.

Pending results of treatability testing to evaluate the effectiveness of treatment of ground water from the new interceptor wells, treatment of the interceptor well water under this remedial alternative may also be reliable over the long-term. Pilot studies have demonstrated that precipitation using lime and ferrous salts is a complex process requiring careful process control.[119] Operational variability was found to be common during the pilot studies,

[119]Baker/TSA, Inc. 1990.

apparently due to the complicated precipitation chemistry for cyanide complexes. The operational variability could be exacerbated by treatment of ground water from the new interceptor wells and additional operations (i.e., activated alumina) in the treatment train. The equipment that would be utilized under this remedial alternative could be reliably maintained over the long-term.

CERCLA requires a five year review whenever the selected remedy will leave wastes on site above levels that allow for unlimited use and unrestricted exposure. Under this alternative, wastes will be left on site; therefore, a five year review would be required.

6.11.4.4 Prevention of Future Exposure

As discussed previously, pumping of the Ormet Ranney well and the interceptor wells will effectively contain the ground-water plume under the Ormet site. Treatment of the ground-water extracted by the interceptor wells by precipitation using lime/ferrous salts, followed by activated alumina adsorption, will reduce constituent concentrations in the extracted ground-water. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. As discussed in Section 6.11.4, regarding the remediation of ground water, restoration of ground-water quality will require an extended period of time. Therefore, under the hypothetical future residential use scenario evaluated in the BRA, there would be a potential for exposure to contaminated ground water through an on-site drinking water well until restoration of the aquifer is achieved. Institutional controls could be imposed to prevent future residential use of the property.

The single barrier clay cap that would be provided over the FSPSA, FDPs, and CMSD under this remedial alternative will reduce the potential for infiltration and transport of constituents. Pumping and treating of the alluvial ground-water, capping with single barrier clay caps, and dredging of Outfall 004 backwater area and river sediments will eliminate direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport. Therefore, Remedial Alternative 10 will eliminate or significantly reduce future exposure to the constituents present at the Ormet site.

6.11.4.5 Potential for Replacement

Due to the high degree of long-term reliability for the ground-water extraction and treatment components of this remedial alternative, the potential need to replace these components over the long-term is low. Potential for repair of single barrier compacted clay caps will be limited to periodic maintenance of the soil cover. Periodic maintenance would include checking perimeter fencing, checking for soil subsidence and erosion, control of burrowing animals (OAC 3745-27-11 (G)(4)), and removal of trees. Proper site inspection, maintenance, and security would serve to reduce the potential for more extensive repair or replacement of the cap components.

6.11.5 Reduction of Mobility, Toxicity, and Volume

This remedial alternative would result in removal of constituents for the ground-water extracted by the interceptor wells, as well as for the CMSD seeps. No volume reductions would result from implementation of Remedial Alternative 10. The mobility of the various organic and inorganic constituents present in the various media at the site would not be reduced under this remedial alternative, although the containment barriers that would be provided under Remedial Alternative 10 would effectively block transport pathways.

6.11.5.1 Quantities Treated or Destroyed

Ground-water extracted by the interceptor wells is one of two media that would undergo treatment or destruction under this remedial alternative. As discussed in Appendix K, the quantity of ground water that would be pumped by two additional interceptor wells located down-gradient of the FSPSA is estimated to be 54 gpm (78,000 GPD).

Based on the estimated maximum seep flowrate of 5 gpm, the total quantity of seep water that would be collected under this remedial alternative is less than 2.7 million gallons per year. Assuming that 50 percent of this water emanates from the seeps along the toe of the CMSD, the total quantity of seep water that would undergo treatment under this alternative is approximately 1.3 million gallons per year. However, it is possible that the seeps would eventually disappear with capping of the CMSD.

Approximately 5,500 CY of sediments will be solidified and consolidated with the CMSD prior to capping under Remedial Alternative 10.

6.11.5.2 Degree of Expected Reductions

Treatment of the ground-water extracted by the existing interceptor wells has been shown to remove cyanide, fluoride, and color. As discussed in Section 3.2.3.3, influent cyanide concentrations of 5.5 to 9.6 mg/L were reduced under carefully controlled pilot plant operations to effluent concentrations of 0.19 to 0.89 mg/L[120]. This corresponds to a cyanide removal efficiency of 90.7 to 96.5 percent. Influent fluoride concentrations of 24 to 34 mg/L were

[120]Baker/TSA, Inc., 1990.

reduced to 10 to 15 mg/L[121]. This corresponds to a fluoride removal efficiency in the range of 55 to 58 percent. Color removal was determined qualitatively by visual observation. Tea-colored influent was associated with a clear effluent. The effectiveness of the treatment system using ground water pumped from wells closer to the source would need to be evaluated through extensive treatability testing.

Under this remedial alternative, oils present in the CMSD seeps would be removed by oil/water separation. Vendor literature indicates that effluent oil and grease concentrations of 10 mg/L are achievable. Dissolved PCBs, if any, present in the separator effluent would be removed by activated carbon adsorption. Activated carbon is highly efficient for removing PCBs.

In utilizing a single barrier clay cap over the CMSD, coupled with regrading, infiltration would be reduced thus eliminating or significantly decreasing generation of the seeps. Following capping, the seeps may stop discharging entirely.

6.11.5.3 Permanence of Treatment

Cyanide and fluoride precipitation utilized in the ground-water treatment system is a permanent treatment. The cyanide and fluoride would be precipitated into a sludge and the sludge would be removed from the system and disposed off-site. Treatment of the CMSD seeps by oil/water separation is also a permanent treatment. The treatment residuals from this treatment process would include free-phase oil and spent activated carbon that may contain PCBs.

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[121] Baker/TSA, Inc., 1990.

6.11.5.4 Treatment Residuals

Treatment residuals resulting from the precipitation process consist of dewatered sludge. Baker/TSA, Inc. estimated that full scale operation of a system to treat ground water pumped from the existing interceptor wells would yield approximately three tons per day of dewatered sludge (filter cake)[122]. Samples of the sludge from the pilot plant were collected and analyzed for reactive cyanide and EP Toxicity. This testing showed that the sludge was not a characteristic hazardous waste[123]. However, extensive pilot testing would need to be performed to determine the effectiveness of the treatment system and the character of the residuals using ground water from wells placed closer to the source.

Treatment residuals would also be associated with treatment of the collected seep water from the CMSD seeps. These residuals would include free-phase oil from the oil/water separator and spent activated carbon from the absorber vessels. The amount of free-phase oil observed on the CMSD seeps during the RI was limited to a light sheen. Consequently, the amount of oil resulting from implementation of this alternative would be minimal. As discussed in Section 5, it was assumed that three containers of activated carbon would be expended quarterly. This equates to approximately 4,800 pounds per year (at 400 pounds per container).

Solidification of the sediments from Outfall 004 backwater area and the river will also generate treatment residuals. The solidified material will increase from 30 to 50 percent by volume, resulting in 7,150 to 8,250 CY (Table 6-13). As previously discussed in Section 6.11.5, the solidified material will be placed in the CMSD prior to construction of the single barrier clay cap over the CMSD.

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[122]Baker/TSA, Inc., 1990.

[123]Baker/TSA, Inc., 1990.

6.11.6 Implementability

Remedial Alternative 10 is potentially implementable within site conditions.

6.11.6.1 Constructability and Operability

This remedial alternative is operable within site conditions, but poses certain constructability problems related to the need to solidify the disposal pond solids prior to construction of a compacted clay cap. The Ormet site is an operating industrial facility with an established and well trained security and maintenance force. Accordingly, the Ormet site is well suited to ensure proper security, maintenance, and operation of the various components of this remedial alternative. There are no construction considerations for the ground-water containment system because the Ormet Ranney well is currently in operation and new interceptor wells could be installed closer to the FSPSA. From a physical standpoint, construction of the ground-water treatment equipment for the lime/ferrous salt precipitation system would not be hindered or adversely impacted by any of the existing conditions on-site. Construction of collection trenches for the CMSD and ballfield seeps would involve relatively shallow excavation depths and could be accomplished using commonly available heavy equipment. Treatability studies would be performed to determine the actual carbon usage for removing dissolved organics from the seeps.

Under Remedial Alternative 10, solidification of the solids from the former disposal ponds would be accomplished using backhoes, crawler-mounted injector-type mixers or a vertical auger mixer/injector. Because the size of Pond 5, clamshell or dragline equipment would probably be required to ensure an adequate reach for mixing the contents of Pond 5 with the solidification agent. Access for this type of equipment would be difficult along the berm of Pond 5 bordering the Ohio River due to the narrowness of the berm. To address the equipment access problem, Pond 5 could potentially be solidified by working progressively from the side adjacent to the former spent potliner storage area toward the river. This progressive approach would not prohibit the use of the equipment described above. The clamshell and dragline equipment required for this purpose is available. The lime and flyash reagents that would be used for solidification under Remedial Alternative 10 are available in the Ohio River valley region. Treatability studies would be required to determine appropriate mixing ratio of the materials in the former disposal ponds with lime and fly ash for solidification. Prior to capping, the solidified material solids would be regraded to provide approximately a 4 percent slope for surface water run-off.

The current ground-water extraction system has operated reliably since its installation. This has required periodic maintenance of the pumps and wells to ensure proper operation. It is anticipated that the operation of interceptor wells located closer to the source would require frequent maintenance of the pumps and well screens, due to the high levels of dissolved constituents and the tendency for the dissolved constituents to precipitate and cause scaling of the pumps and well screens.

Pilot studies have demonstrated that treatment of the ground-water extracted by the existing interceptor wells requires careful process control[124]. Operational variability was found to be common during the pilot studies due to the complex chemistry involved in cyanide precipitation. Subsequent pilot studies demonstrated that the lime/ferrous salt precipitation process can be operated within the design/operating conditions. However, operational variability of the system may be compounded due to the chemical composition of ground water from new interceptor wells.

[124]Baker/TSA, Inc., 1990.

Construction of single barrier compacted clay caps would require specialized equipment for compaction and testing. This equipment would be utilized under the supervision of a qualified specialty installer.

The sediments from the Outfall 004 backwater area and river could potentially be dredged using equipment that is readily available along the Ohio River. Once situated on top of the CMSD, earthmoving equipment could be utilized to solidify the sediments with lime and flyash. Treatability studies would be performed to determine the proper mixing ratio of sediments with binding agent for solidification.

There are no operability considerations associated with the containment components of Remedial Alternative 10. However, periodic inspection of the caps would be required. Repairs could be performed if so indicated by these inspections.

6.11.6.2 Ability to Phase Into Operable Units

The component remedial measures that constitute Remedial Alternative 10 provide certain opportunities for phasing remediation of the Ormet site in operable units. For example, the following elements could be managed as operable units:

- ground-water extraction and treatment;
- seep collection and treatment; and
- containment measures.

Several of these component remedial measures must be implemented sequentially. For example, excavation of the carbon run-off and deposition area must be performed prior to capping of the CMSD because the carbonaceous materials would be contained in the CMSD. Similarly, excavation of the carbon run-off and deposition area must be performed prior to dredging and placement of concrete revetments in the Outfall 004 backwater area because the outfall drainage ditch would be rerouted through the carbon run-off and deposition area.

6.11.6.3 Ability to Monitor Effectiveness

The short-term and long-term effectiveness associated with implementation of Remedial Alternative 10 could be effectively monitored through use of the existing network of ground-water monitoring wells. These wells could be used for periodic ground-water level measurements to confirm that the ground-water extraction system continues to contain the plume on-site. These wells would also be effective for periodic sampling to monitor plume distribution and constituent concentrations. Periodic ground-water quality data will also provide the best means of adjusting projections of the time required to achieve reductions in contaminant concentrations.

Cap inspections would be performed quarterly to monitor the integrity of the cap barrier. Inspections would include checking for differential settlement or soil subsidence, erosion, leachate outbreaks, surface water ponding, and stressed vegetation.

The collection trenches for the CMSD and ballfield seeps would provide an opportunity to effectively monitor the flowrate of the seeps. Additionally, the discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized effectively to monitor the chemical composition and concentrations of the discharges.

Additional remedial action could be instituted if monitoring indicates that such actions are needed. The former disposal ponds, former spent potliner storage area, CMSD, and CRDA would not pose a problem, since these areas would be contained with no treatment. Additional remedial actions for ground water and the seeps would require modifications to the treatment systems. Changes of this nature would be difficult to implement. Sediments would be dredged for consolidation within the CMSD and stabilized, which would result in increased volume. After stabilization, the sediments would be capped, thus further remedial action on the sediments would be difficult.

6.11.6.4 Ability to Obtain Approvals

Certain approvals would be required for implementation of Remedial Alternative 10. Approvals would be required for construction of the ground-water treatment system for the interceptor wells that is included in this remedial alternative. Approval to construct this system would be in the form of a Permit-to-Install. Similarly, a PTI may be required for the CMSD seep collection and treatment system, and for the ballfield seep collection system.

Approvals would also be required for discharges to surface-water under the NPDES program. The NPDES permit for the Ormet facility will govern discharges to surface water under this remedial alternative. Pursuant to the terms of an easement granted to the United States, approvals may be necessary from the U.S. Army Corps of Engineers (USACOE) prior to any bank improvements involving any dredge or fill activities along the edge of the Ohio River and the Outfall 004 backwater area.

6.11.6.5 Availability of Off-Site Services and Capacity

Off-site transportation and disposal services would be required for the treatment residuals discussed in Section 6.11.5.4. Under this remedial alternative, the sludge resulting from the lime/ferrous salt precipitation process would be handled by off-site landfilling. The required transportation and disposal services for these residuals exist within USEPA Region V[125]. Adequate disposal capacity is commercially available for these materials.

Free-phase oil, if any, resulting from treatment of the CMSD seeps would be handled by off-site facilities. Due to the potential presence of PCBs in the oil, it has been assumed that the oil would be treated by incineration. The required transportation and disposal services for the oil exist within USEPA Region V[126]. Adequate disposal capacity is commercially available.

Spent activated carbon resulting from treatment of the CMSD seeps would also be handled by off-site facilities under Remedial Alternative 10. Due to the relatively small quantity of spent carbon, regeneration is not feasible for this material. Commercial suppliers of activated carbon were contacted regarding the availability of regeneration services for carbon that would contain PCBs. These services do not exist. Consequently, the spent activated carbon would be managed by off-site landfill disposal or thermal treatment. The required transportation and disposal services are available. Adequate disposal capacity is also available for the spent activated carbon.

6.11.6.6 Availability of Equipment and Specialists

Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components of this remedial alternative. However, trained operators would be required for the ground-water treatment equipment, as well as the CMSD seep treatment system.

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[125]USEPA, et. al., 1990.

[126]USEPA, et. al., 1990.

Specialized equipment and skilled workers would be required for installation of the single barrier caps under this remedial alternative. However, the required materials and services are available through a variety of commercial sources.

Skilled workers would not be required for the removal of the sediments in the Outfall 004 backwater area and the river. Installation of steel sheet piling as an operational control during dredging would require specialized equipment. Pile driving equipment and the required personnel are available for both land-driven and barge-driven installations.

6.11.7 Cost

The capital and O&M costs that would be incurred through implementation of Remedial Alternative 10 are presented in this Section.

6.11.7.1 Capital Cost

The capital costs for Remedial Alternative 10 are summarized in Table 6-51. Details regarding the capital costs for various components of this remedial alternative are provided in the following tables:

- Table 6-3: Estimated Capital Costs for Sitewide Institutional Controls
- Table 6-45: Estimated Capital Costs for Ground-Water Treatment System Under Remedial Measure GW-5
- Table 6-6: Estimated Unit Costs Utilized for Estimating Containment Costs

TABLE 6-51. Summary of Capital Costs for Sitewide Remedial Alternative 10

COST ELEMENT	REFERENCE TABLE	ESTIMATED COST
1. Sitewide Institutional Controls	6-3	$81,008
2. Ground-Water Treatment	6-45	$3,202,580
3. Seep Collection and Treatment System	6-7	$69,550
4. Solidification	6-20	$7,924,380
5. Containment	6-52	$6,569,530
6. Sediment Dredging	6-53	$402,015
7. New Interceptor Wells	6-50	$93,497
	SUBTOTAL	$18,342,560
Engineering/Design (10%)		$1,834,256
Installation/Shakedown (5%)		$168,281
	SUBTOTAL	$20,345,097
Contingency		$4,069,019
	SUBTOTAL	$24,414,116
Ground-Water Treatment O&M (Years 1-10) {1}	6-49	$13,008,597
	TOTAL	$37,422,713
	ROUND	$37,000,000

{1} Reflects 10-year present worth at 10%.

- Table 6-7: Estimated Capital Costs for Seep Collection and Treatment System
- Table 6-50: Estimated Capital Costs for New Interceptor Wells Under Remedial Measure GW-5
- Table 6-52: Estimated Capital Costs for Containment Under Remedial Alternative 10
- Table 6-53: Estimated Capital Costs for Sediment Dredging and Solidification Under Remedial Measure SED-10

6.11.7.2 Operating and Maintenance Costs

The operating and maintenance costs that would be incurred through implementation of Remedial Alternative 10 are summarized in Table 6-54. The O&M costs for the ground-water extraction and treatment components of this remedial alternative are summarized in Table 6-10. The O&M costs for collection and treatment of the CMSD seeps are presented in Table 6-11. O&M costs associated with the containment components of Remedial Alternative 10 are presented in Table 6-12.

6.11.7.3 Present Worth

The present worth of Remedial Alternative 10 was calculated to be $408,000,000. This value was calculated in accordance with USEPA guidance[127] utilizing an operating period of 30 years and a discount rate of 10 percent.

[127]USEPA, 1987.

TABLE 6-50. Summary of Capital Costs for New Interceptor Wells Under Remedial Measure GW-5

COST ELEMENT	ESTIMATED QUANTITY	UNIT	UNIT COST	ESTIMATED COST
1. WELL DRILLING & INSTALLATION	2	each	$30,000	$60,000
2. EQUIPMENT				
Submersible Pump	2	each	$1,500	$3,000
Controls/Meters	1	LS	$2,000	$2,000
			SUBTOTAL	$5,000
3. DELIVERY PIPING				
Excavate	1,800	LF	$0.69	$1,242
Backfill	1,800	LF	$1.04	$1,872
Pipe Bedding	65	T	$8.05	$523
6" Pipe Installation	1,800	LF	$10.20	$18,360
			SUBTOTAL	$21,997
4. SITE IMPROVEMENTS				
Power Supply	1	LS	$3,000	$3,000
Wellhead Protection (Shed)	2	each	$1,500	$3,000
Concrete	5	CY	$300	$1,500
			SUBTOTAL	$6,500
			TOTAL {1}	$93,497
			ROUND	$93,000

{1} Indirect capital costs and contingencies for the new interceptor wells are included in the summaries for the sitewide alternative.

Table 6-52. Estimated Capital Costs for Containment Under Remedial Alternative 10.

COST ELEMENT	ESTIMATED QUANTITY	UNIT	UNIT COST	ESTIMATED COST
1. SINGLE BARRIER CAP (CMSD)				
Fill (Placement)	5,000	CY	$2.08	$10,400
Grading	90,000	CY	$8.23	$740,700
Clay (Transport)	20,000	CY	$19.00	$380,000
Clay (Placement)	20000	CY	2.08	$41,600
Geonet	270,000	SF	$0.26	$70,200
Geotextile (10 oz.)	540,000	SF	$0.18	$97,200
Borrow (Transport)	13,000	CY	$5.00	$65,000
Borrow (Placement)	13,000	CY	$9.82	$127,660
Rip-Rap	860	T	$31.85	$27,391
Hydroseeding	270,000	SF	$0.04	$10,800
			SUBTOTAL	$1,570,951
3. SINGLE BARRIER CAPS (FDPs)				
Fill (Transport)	21,700	CY	$17.04	$369,768
Fill (Placement)	43,750	CY	$2.08	$91,000
Clay (Transport)	60,600	CY	$19.00	$1,151,400
Clay (Placement)	$60,600	CY	2.08	$126,048
Geonet	818,000	SF	$0.26	$212,680
Geotextile (10 oz.)	1,636,000	SF	$0.18	$294,480
Borrow (Transport)	39,400	CY	$5.00	$197,000
Borrow (Placement)	39,400	CY	$9.82	$386,908
Hydroseed	818,000	SF	$0.04	$32,720
			SUBTOTAL	$2,862,004
4. SINGLE BARRIER CAP (FSPSA)				
Fill (Transport)	16,300	CY	$11.36	$185,168
Fill (Placement)	22,500	CY	$2.08	$46,800
Clay (Transport)	45,000	CY	$19.00	$855,000
Clay (Placement)	45,000	CY	2.08	$93,600
Geonet	610,000	SF	$0.26	$158,600
Geotextile (10 oz.)	1,220,000	SF	$0.18	$219,600
Borrow (Transport)	30,000	CY	$5.00	$150,000
Borrow (Placement)	30,000	CY	$9.82	$294,600
Hydroseed	610,000	SF	$0.04	$24,400
			SUBTOTAL	$2,027,768
5. CONSOLIDATE CRDA IN CMSD				
Clearing/Grubbing	4.5	acre	$2,800.00	$12,600
Excavation	5,700	CY	$6.15	$35,055
Borrow (Transport)	3,600	CY	$5.00	$18,000
Borrow (Placement)	3,600	CY	$9.82	$35,352
Hydroseeding	195,000	SF	$0.04	$7,800
			SUBTOTAL	$108,807
			TOTAL {1}	$6,569,530
			ROUND	$6,600,000

{1} Indirect capital costs and contingencies for the containment system are included in the summary for overall remedial alternatives.

TABLE 6-53. Estimated Capital Costs for Complete Sediment Dredging and Solidification Under Remedial Measure SED-10.

COST ELEMENT	ESTIMATED QUANTITY	UNIT	UNIT COST	ESTIMATED COST
1. CONSOLIDATE SEDIMENTS IN CMSD				
Steel Sheet Piling (Temporary)	3,000	SF	$46	$138,000
Silt Curtains	1	LS	$40,000	$40,000
Dredging	5,500	CY	$33	$181,500
			SUBTOTAL	$359,500
2. SOLIDIFICATION				
Flyash (Transport)	2,750	CY	$6.00	$16,500
Flyash (Placement)	2,750	CY	$2.08	$5,720
Flyash (Mixing)	8,250	CY	$2.46	$20,295
			SUBTOTAL	$42,515
			TOTAL {1}	$402,015
			ROUND	$400,000

{1} Indirect capital costs and contingencies for the complete sediment dredging are included in the summary for overall remedial alternatives.

TABLE 6-54. Summary of O&M Costs for Sitewide Remedial Alternative 10.

COST ELEMENT	REFERENCE TABLE	ESTIMATED ANNUAL COST
1. Sitewide Institutional Controls	6-9	$28,325
2. Seep Collection and Treatment System	6-11	$19,786
3. Containment	6-12	$88,000
4. Ground-water Treatment	6-49	$2,117,078
	SUBTOTAL	$2,253,189
Administration (12%)		$270,383
	SUBTOTAL	$2,523,572
Contingency (20%)		$504,714
	TOTAL	**$3,028,286**
	ROUND	**$3,000,000**

TOTAL PRESENT WORTH (10% PRESENT WORTH FACTOR) 30 Year Operation with Ground-Water Treatment O&M for Years 1-10 Included in Capital Cost of Alternative.	$11,000,000

7.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the sitewide remedial alternatives for the Ormet site was evaluated on an individual basis in the previous section. This Section constitutes a comparative analysis wherein the relative performance of each alternative will be evaluated with respect to each evaluation criterion. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another. In general, the alternative(s) that perform best in each evaluation criterion are discussed first, with other alternatives discussed in relative order of performance. For remedial alternatives that employ innovative technologies, the potential advantages in cost or performance and the degree of uncertainty in their expected performance, as compared with more demonstrated technologies, will be discussed. A summary of the evaluation of the site-wide remedial alternatives is provided in Table 7-1.

Certain aspects of the comparative analysis of alternatives will be presented qualitatively whereas other aspects will be quantitative. Quantitative information will include cost estimates, time until response objectives would be attained, and residual constituent concentrations.

7.1 Compliance with ARARs

The ability of the sitewide remedial alternatives to attain compliance with the chemical-, location-, and action-specific ARARs established for the Ormet site will be evaluated in this Section. Table 7-2 summarizes a comparison of ARAR compliance for the remedial alternatives at the Ormet site.

TABLE 7-1
SUMMARY OF ALTERNATIVE EVALUATION

ALT. NO.	OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT	ARAR COMPLIANCE	SHORT TERM EFFECTIVENESS	LONG TERM EFFECTIVENESS AND RELIABILITY	REDUCTION OF TOXICITY, MOBILITY AND VOLUME	OVERALL IMPLEMENTABILITY	PRESENT NEW WORTH
1	No	No	Poor	Poor	Poor	Fair	$0
2	Yes	Yes	Good	Fair-Good	Fair	Excellent	$15,400,000
3	Yes	Yes	Excellent	Excellent	Good	Good - Very Good	$19,400,000
4	Yes	Yes	Excellent	Excellent	Good	Fair	$32,400,000
5	Yes	Yes	Excellent	Excellent	Good	Good - Very Good	$21,400,000
6	Yes	Yes	Good - Very Good	Excellent	Very Good	Poor - Fair	$123,000,000
7	Yes	Yes	Good	Excellent	Very Good	Poor - Fair	$124,000,000
8	Yes	Yes	Good - Very Good	Excellent	Good	Good - Very Good	$19,400,000
9	Yes	Yes(1)	Good	Excellent	Very Good - Excellent	Poor - Fair	$145,000,000
10	Yes	Yes(1)	Excellent	Excellent	Good	Fair - Good	$48,000,000

1 - Ability to comply with NPDES discharge limitations is uncertain

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:1501:21-5 02-06	Design requirements of dams, dikes and levees	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:1501:21-11 03-05	Predesign investigations (dams, dikes, levees)	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:1501:21-13 02-08	Additional design requirements for dams	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:1501:21-13 10-14	Additional design requirements for dikes and levees	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:1501:21-15 06	Operation, maintenance and inspections	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:1501:21-21 03-04	Deficiency and O&M of dams, dikes and levees	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-1-03	Analytical and Sample Collection procedures	NP	A	A	A	A	A	A	A	A	A

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-1-04	The "Five Freedoms" for surface water	NA	A	A	A	A	A	A	A	A	A
OAC:3745-1-05	Antidegradation Policy for surface water	NA	A	A	A	A	A	A	A	U	U
OAC:3745-1-06	Mixing zones for surface water	NA	A	A	A	A	A	A	A	U	U
OAC:3745-1-32	Water use designations for Ohio River	NA	A	A	A	A	A	A	A	U	U
OAC:3745-9-04 A,B	Location/siting of new ground water wells	NP	NP	NP	NP	NP	NP	NP	NP	A	A
OAC:3745-9-05 A1,B-H	Construction of new ground water wells	NP	NP	NP	NP	NP	NP	NP	NP	A	A
OAC:3745-9-06 A,B,D,E	Casing requirements for new ground water wells	NP	NP	NP	NP	NP	NP	NP	NP	A	A
OAC:3745-9-07 A-F	Surface design of new ground water wells	NP	NP	NP	NP	NP	NP	NP	NP	A	A
OAC:3745-9-08 A,C	Start-up & operation of ground-water wells	NP	NP	NP	NP	NP	NP	NP	NP	A	A
OAC:3745-9-09 A-C,D1,E-G	Maintenance & operation of ground-water wells	NP	A	A	A	A	A	A	A	A	A
OAC:3745-9-10 A,B,D	Abandonment of test holes & ground water wells	NP	A	A	A	A	A	A	A	A	A
OAC:3745-9-11	Use of ground water wells for disposal	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.
U - Uncertain

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-15-06 A1,A2	Malfunction and maintenance of air pollution control equipment	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-15-07(A)	Prohibition of air pollution nuisances	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-16-02 B,C	Stack height requirements	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-17-02 A,B,C	Particulate ambient air quality standards	NA	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-17-05	Particulate non-degradation policy	NA	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-17-07 A-D	Visible particulate emission control	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-17-08 A1,A2,B,D	Emission restrictions for fugitive dust	NP	A	A	A	A	A	A	A	A	A
OAC:3745-17-09 A,B,C	Incinerator particulate emissions and odor restrictions	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-17-10 A,B,C	Fuel burning particulate emission restrictions	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-18-02 A,B,C,D	Sulfur dioxide ambient air quality standards	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-18-05 A	Sulfur dioxide ambient monitoring requirements	NP	NP	NP	NP	NP	A	A	NP	A	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-18-06 A-G	Sulfur dioxide emission limit provisions	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-19-04 A,B,C,D	Open burning standards in unrestricted areas	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-21-02 A,B,C	Ambient air quality standards for carbon oxides	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-21-05	Carbon monoxide non-degradation policy emission control	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-21-07 A-J	Organic material emission control stationary source	NA	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-21-08	Carbon monoxide emission control	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-21-09	VOC emission control: stationary source	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-23-04	Nitrogen oxide (NOx) Nondegradation policy	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-23-06	Nitrogen oxide emission control	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-25-03	Emission control action programs	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-27-05 A,B,C	Authorized, limited & prohibited solid waste disposal	NP	NA	A	A	A	A	A	A	A	A

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-27-06 B,C	Required technical information for sanitary landfills	NA	NA	A	NP	A	A	A	A	A	A
OAC:3745-27-07 A,B	Location criteria for solid waste disposal permit	NA	NA	A	NP	A	A	A	A	A	A
OAC:3745-27-08 C,D,E	Construction specifications for sanitary landfills	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-27-09 C-F,I,L-O	Sanitary landfill operational requirements	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-27-10 B,C,D	Sanitary landfill ground-water monitoring requirements	NA	A	A	NP	A	A	A	A	A	A
OAC:3745-27-11 A,B,G	Final closure of sanitary landfills	NA	NA	A	NP	A	A	A	A	A	A
OAC:3745-27-12 B,E	Sanitary landfill explosive gas monitoring	NA	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-27-13 A,E-G,J	Disturbances where solid or hazarous waste facility was operated	NP	A	A	A	A	A	A	A	A	A
OAC:3745-27-14 A	Post-closure care of sanitary landfill facilities	NA	A	A	NP	A	A	A	A	A	A
OAC:3745-31-05	Water/air permit criteria for decision by the director	NP	A	A	A	A	A	A	A	A	A

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-32-05	Water quality criteria for decision by the director	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-50-44	Permit info required for all hazardous waste facilities	NA	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-50-44 B	Permit info required for all hazardous waste land disposal facilities	NA	NP	NP	A	NP	NP	A	NP	A	NP
OAC:3745-50-44 C1	Additional permit info: hazardous waste storage in containers	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-50-44 C2	Additional permit info: hazardous waste storage/ treatment in tanks	NA	A	A	A	A	A	A	A	A	A
OAC:3745-50-44 C3	Additional permit info: hazardous waste storage/ treatment in surface impoundments	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-50-44 C4	Additional permit info: hazardous waste storage/treatment in waste piles	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-50-44 C5	Additional permit info: hazardous waste treatment/disposal by land treatment	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-50-44 C6	Additional permit info: environmental performance standards	NA	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-50-44 C7	Additional permit info: hazardous waste disposal in landfills	NA	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-50-44 C8	Additional permit info: hazardous waste treatment by incineration	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-50-44 C9	Additional permit info: hazardous waste T/S/D in misc units	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-50-58 A,E,H-J	Hazarous waste facility permit conditions	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-50-62 A,B,C,D	Trial burn for incinerators	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-50-221 A,B	Petitions to exclude a listed waste at a facility	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-51-07 A,B	Residues of hazardous wastes in empty containers	NP	A	A	A	A	A	A	A	A	A
OAC:3745-52-11 A-F	Evaluation of wastes	NP	A	A	A	A	A	A	A	A	A
OAC:3745-54-13 A	General Analysis of hazardous wastes	NP	A	A	A	A	A	A	A	A	A

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-54-14 A,B,C	Security for hazardous wastes facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-15 A,C	Inspection requirements for hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-17 A,B,C	Requirements for ignitable, reactive or incompatable hazardous wastes	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-54-18 A,B,C	Location standards for hazardous waste T/S/D facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-31	Design and operation of hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-32 A,B,C,D	Required equipment for hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-33	Testing and maintenance of equipment - hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-34	Access to communications or alarm sysem - hazardous waste facility	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-35	Required aisle space at hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-54-37 A	Arrangements with local authorities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-52 A-F	Contingency Plan - hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-54 A	Amendment of contingency plan - hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-55	Emergency coordinator - hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-56 A-I	Emergency procedures hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-91 A	Regulatory ground-water programs for hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-92	Ground-water protection standard; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-93 A,B	Hazardous constituents in ground water; hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-94 A,B	Concentration limits for ground water; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-54-95 A,B	Point of compliance; for ground-water; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-96 A,B,C	Compliance period for ground water; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-97 A-H	General ground-water monitoring requirements; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-98 A-I	Ground water detection monitoring program; hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-54-99 A-J	Ground-water compliance monitoring program Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-01 A-F	Ground-water corrective action program; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-11 A,B,C	General closure performance standard; Hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-12 B	Content of closure plan; hazardous waste facilities	NP	NP	NP	A	NP	A	A	NP	A	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-55-14 B	Disposal and decontamination of equipment, structures, and soils	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-16	Submission of survey plat following closure	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-17 B	Post-closure care and use of the property	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-18 B	Post-closure plan	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-19	Notice to local land authority	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-71	Condition of containers	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-72	Compatability of waste with containers	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-73	Management of containers	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-74	Container inspections	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-75 A,B,C,D	Container storage area containment system	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-76	Container requirements for ignitable/reactive wastes	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-55-78	Container closure requirements	NP	NP	NP	A	NP	A	A	NP	A	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-55-92 A-G	Design & installation of new tank systems or components	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-55-93 A-G,I	Containment and detection of release for tank systems	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-55-94 A,B,C	General operating requirements for tank systems	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-55-95 A-D	Inspections of tank systems	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-55-96 A,B,C,E	Response to leaks or spills of tank systems	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-55-97 A,B	Closure and post-closure care for tank systems	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-55-98	Tank requirements for ignitable/reactive wastes	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-56-21 A-G 56-26 A,B,C, 56-27 A-E 56-28 A,B,C, 56-29 A,B 56-31 A	Management of hazardous wastes in surface impoundments	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-56-51 A-F	Design & operating requirements of waste piles	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-56-54 A,B	Monitoring & inspection of waste piles	NP	NP	NP	A	NP	A	A	NP	A	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-56-56 A,B	Waste pile requirements for ignitable/reactive wastes	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-56-58 A,B,C	Closure & post-closure care for waste piles	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-56-59 A	Construction inspections for waste piles	NP	NP	NP	A	NP	A	A	NP	A	NP
OAC:3745-57-01 A-D	Environmental performance standards-land-based units.	NP	NP	NP	A	NP	A	A	NP	A	NP
57-03 A-I, 57-05 A,B 57-10 A,B, 57-12 A,B 57-17 A	Management of hazardous waste in landfills	NP	NP	NP	A	A	A	A	A	A	NP
OAC:3745-57-41 A,B 57-42 A,B,C, 57-43 A,B,C 57-44 C, 57-45 A-F 57-47 A,B,C	Treatment of hazarouds waste in incinerators	NP	NP	NP	NP	NP	A	A	NP	A	NP
OAC:3745-57-91 A,B,C	Environmental performance standards for misc units	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-57-92	Monitoring, inspecting, analyzing,... for miscellaneous units	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-57-93	Post-closure care for misc disposal units	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-11 A,B	Maximum contaminant levels for inorganic chemicals	NA	A	A	A	A	A	A	A	A	A

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-81-12 A,B,C	Maximum contaminant levels for organic chemicals	NA	A	A	A	A	A	A	A	A	A
OAC:3745-81-13 A,B	Maximum contaminant levels for turbidity	NA	A	A	A	A	A	A	A	A	A
OAC:3745-81-14 A	Maximum microbiological contaminant levels	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-15 A,B	Maximum contaminant levels for radium 226, 228, gross alphas	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-16 A,B	Maximum contaminant levels for BETA particle & photon radioactivty	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-21 A	Microbiological contaminant sampling & analytical requirements	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-22 A	Turbidity sampling and analytical requirements	NA	A	A	A	A	A	A	A	A	A
OAC:3745-81-23 A	Inorganic monitoring requirements	NA	A	A	A	A	A	A	A	A	A
OAC:3745-81-24 A-E	Organic monitoring requirements	NA	A	A	A	A	A	A	A	A	A
OAC:3745-81-25 A-D	Analytical methods for radioactivity	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-26 A,B	Monitoring frequency for radioactivity	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
OAC:3745-81-27 A,B,C	Analytical techniques	NA	A	A	A	A	A	A	A	A	A
OAC:3745-81-40 A,B,C	Requirements for a variance for MCLs	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3745-81-46	Alternative treatment technique variance	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
OAC:3767.13	Prohibition of Nuisances	NP	A	A	A	A	A	A	A	A	A
ORC:1521.06	Construction permits for dams, dikes and levees	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
ORC:1521.062	Monitoring, maintenance & operation (dams, dikes, levels)	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
ORC:3734.02(F)	Unauthorized storage, treatment, or disposal of hazardous waste	NP	A	A	A	A	A	A	A	A	A
ORC:3734.02(H)	Earth moving activity where hazardous or solid waste facility was located	NP	A	A	A	A	A	A	A	A	A
ORC:3734.02(I)	Air emissions from hazardous waste facilities	NP	NP	NP	NP	NP	A	A	NP	A	NP
ORC:3734.05 (D) (6) (c)	Hazardous waste facility environmental impact	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
ORC:3734.05 (D) (6) (d)	Hazardous waste facility minimum risk	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
ORC:6101.19	Conservancy districts	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
ORC:6111.04	Acts of pollution prohibited	NP	A	A	A	A	A	A	A	U	U

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.
U - Uncertain

Table 7-2 - Comparison of ARAR Compliance for Remedial Alternatives at the Ormet Site (Continued)

Regulatory Citation/Pertinent Paragraph	Title/Subject of Regulation	Remedial Alternative 1	Remedial Alternative 2	Remedial Alternative 3	Remedial Alternative 4	Remedial Alternative 5	Remedial Alternative 6	Remedial Alternative 7	Remedial Alternative 8	Remedial Alternative 9	Remedial Alternative 10
ORC:6111.042	Requirements for compliance with National Effluent Standards	NP	A	A	A	A	A	A	A	U	U
ORC:6111.043	Liquid disposal permit	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
ORC:6111.45	Approval of plans for disposal of wastes	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
40 CFR 760.60(a)(5)	PCB Disposal Requirements for Dredged Materials	NP	NP	NP	A	NP	A	A	NP	A	A
40 CFR 760.60(e)	PCB Disposal Requirements for Treatment Other than Incineration	NP	NP	NP	A	NP	A	A	NP	A	A
40 CFR 761.70	Incineration	NP	NP	NP	NP	NP	A	A	NP	A	NP
40 CFR 761.75	Chemical Waste Landfill	NP	NP	NP	NP	NP	NA	NA	NP	NA	A
40 CFR 50.6	National Ambient Air Quality Standards for Particulate Matter	NP	A	A	A	A	A	A	A	A	A

A - Would be attained.
NA - Would not be attained.
NP - Not pertinent to this alternative.
U - Uncertain

7.1.1 Chemical-Specific ARARs

Remedial Alternatives 2 through 8 would attain chemical-specific ARARs established for the site. With respect to chemical-specific ARARs for surface-water discharge quality, Alternatives 2 through 8 would comply with NPDES effluent limitations currently proposed for the site. Remedial Alternatives 9 and 10 could potentially achieve NPDES effluent limitations. However, extensive treatability testing would be required to determine whether ground water pumped from interceptor wells installed closer to the source could be treated to achieve the proposed limits. Remedial Alternative 1 would not be subject to these ARARs, since there would be no ground-water containment or extraction under the no-action alternative.

Remedial Alternatives 2 through 10 could also attain compliance with chemical-specific ARARs for aquifer quality. Operation of the existing interceptor wells (GW-3) is projected to result in the reduction of total cyanide concentrations in that portion of the alluvial aquifer immediately downgradient of the FSPSA to or below the MCL in 38 years, under current site conditions. Operation of interceptor wells placed closer to the source (GW-5) is projected to result in the reduction of total cyanide concentrations at the pumping wells to or below the MCL in approximately 36 years, under current site conditions. A more detailed discussion of these projected timeframes is provided in Appendix K. Source control measures, in the form of single and/or dual barrier caps or soil flushing would be expected to reduce these timeframes somewhat, but the extent of the reduction is uncertain. It is anticipated that the extent of the reduction related to single and dual barrier caps would be comparable.

Remedial Alternatives 2, 3, 4, 5, and 8 would not be subject to the land disposal restrictions (LDRs) as chemical-specific ARARs. The excavation and consolidation of the carbonaceous material from the CRDA that would be performed under these alternatives is not subject to the LDRs, because the carbonaceous material is not a listed or characteristic hazardous waste.

7.1.2 Location-Specific ARARs

Remedial Alternatives 2 through 10 would comply with federal and state location-specific ARARs regarding location criteria for solid waste landfills. Under these alternatives, the sideslopes of the CMSD bordering the Ohio River and the Outfall 004 backwater area would be largely removed from the 100-year floodplain by regrading. These actions would be protective of human health and the environment, however, a small portion of the material in the CMSD would remain below the 100-year flood elevation. This portion of the CMSD sideslopes would be protected from washout by placement of riprap or concrete revetments. Remedial Alternative 1 would not attain compliance with federal and state location-specific ARARs.

7.1.3 Action-Specific ARARs

Remedial Alternatives 2, 3, 4, 5, 8, and 10 would comply with all action-specific ARARs established for the site that pertain to those alternatives. Remedial Alternatives 6, 7, and 9 would comply with the majority of action-specific ARARs that pertain to those alternatives. Since Remedial Alternative 1 involves the absence of remedial response actions, there are no action-specific ARARs that pertain to this Alternative.

With regard to SQCs (TBC information - Appendix F), Remedial Alternatives 1, 3, 5 and 8 do not attain in the remedial goals. Remedial Alternatives 2, 4, 6, 7, and 9 would achieve the SQCs.

7.2 Overall Protection

Remedial Alternatives 2 through 10 would be protective of human health and the environment. Each of the potential human health and environmental exposure pathways assumed in the Baseline Risk Assessment would be effectively addressed under these alternatives.

Therefore, potential impacts to human health or the environment will be eliminated under these alternatives.

Remedial Alternative 1 would not enhance protection of human health or the environment because the source materials present on-site would not be contained, treated or destroyed.

7.3 Short-Term Effectiveness

The effectiveness of each sitewide remedial alternative over the short-term is compared in this Section. Table 7-3 summarizes the short-term effectiveness criteria for each remedial alternative.

7.3.1 Time Until Protection is Achieved

Remedial Alternatives 2, 3, and 5 could be fully constructed and operational in a period of 2 to 4 years. Therefore, the human health and environmental protection afforded by these Alternatives and the remedial response objective of blocking direct exposure pathways could be achieved within 2 to 4 years. Remedial Alternatives 4, 7 and 9 and would require 3 to 5 years for construction due to the more complicated capping systems under these alternatives and the need to stabilize/solidify the disposal ponds prior to construction of the caps. Therefore, the remedial response objective of blocking direct exposure pathways would be achieved after construction of the capping systems.

Remedial Alternatives 7 and 8 would be protective of human health and the environment both during and after the in-situ soil flushing component of these alternatives. For purposes of this FS, it was assumed that in-situ soil flushing in the former spent potliner storage area would be performed for a period of 10 years or until constituent concentrations in the alluvial aquifer reach asymptotic levels over time. Due to the limited data available on this technology, the

Table 7-3 - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
1.No Action	Would not result in an increased level of protection for human health and the environment.	No short-term reliability considerations.	No increased protection of the community.	No worker protection considerations.
2.Containment	Protection and remedial action objectives achievable within 2 - 4 years of remedy selection. Containment of ground-water plume would be achievable immediately, although MCLs would not be attained in the near term. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Protectiveness associated with the vegetated soil cover components would be achievable within 2 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells. Containment of the former spent potliner storage area, former disposal ponds, CMSD, and the Outfall 004 backwater area sediments would be performed in the short-term. The soil covers over the FSPSA, FDPs, and CMDS would be effective in eliminating direct contact and would reduce infiltration by approximately 33 percent. Consequently, some leaching of constituents would continue.	Would not adversely impact the health or safety of the community during construction. Regrading of CMSD, former spent potliner storage area, and the former disposal ponds and the excavation of the carbonaceous material from the CRDA and placement in the CMSD prior to capping could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
3.Containment	Protection and remedial action objectives achievable within 2 - 4 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells.	Would not adversely impact the health or safety of the community during construction. Regrading of CMSD, former spent potliner storage area, and the former disposal ponds, dredging of the sediments in the Outfall 004 backwater area and the excavation of the carbonaceous material from the CRDA and placement in the CMSD prior to capping could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
4. Containment	Protection and remedial action objectives achievable within 3 - 5 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Solidification of the pond solids would require approximately 1 to 2 years. Solidification of the excavated sediments from Outfall 004 backwater area could be very short. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells. Silt curtains and sheet piling utilized during dredging would be effective in the short-term for controlling the transport of sediments.	Would not adversely impact the health or safety of the community during construction. Regrading of CMSD, former spent potliner storage area, and the former disposal ponds, solidification of the pond solids and the dredged sediments and the excavation of the carbonaceous material from the CRDA and placement in the CMSD prior to capping could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal. Silt curtains and sheet piling utilized as operational controls will aid in protecting the community during dredging operations.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
5.Containment/Off-Site Disposal	Protection and remedial action objectives achievable within 2 - 4 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Excavation of up to 4,000 CY of soils from the former spent potliner area could be implemented in 1 to 2 years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells.	Would not adversely impact the health or safety of the community during construction. Excavation and regrading of the former spent potliner storage area, regrading of the CMSD and the former disposal ponds, dredging of the sediments and the excavation of the carbonaceous material from the CRDA and placement in the CMSD prior to capping could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
6.Treatment/Containment	Protection and remedial action objectives achievable within 13 to 15 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Excavation of up to 4,000 CY of soils from the former spent potliner storage area could be implemented in 1 to 2 years. Stabilization of the pond solids and sediments would require approximately 1 to 2 years. Thermal oxidation of the material from the CMSD would require 4 to 10 years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells.	Would not adversely impact the health or safety of the community during construction. Regrading of CMSD, former spent potliner storage area, and the former disposal ponds, and the stabilization of the former disposal ponds solids and the dredged sediments could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal. Air pollution controls utilized on the thermal treatment equipment would be protective of human health and the environment.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
7.Treatment/Containment	Protection and remedial action objectives achievable within 10 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Solidification of the pond solids and sediments would require approximately 1 to 2 years. Thermal oxidation of the material from the CMSD would require 4 to 10 years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years. Solvent extraction of the dredged sediments would be completed within 1 to 2 months following completion of design and procurement. It is assumed that in-situ soil flushing would operate for 10 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells. Treatment of the dredged sediments would be completed in 1 to 2 months following completion of design and procurement.	Would not adversely impact the health or safety of the community during construction. Excavation of the CMSD, regrading of the former spent potliner storage area, and the former disposal ponds, dredging of the Outfall 004 backwater area sediments, and solidification of the former disposal pond solids could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal. No air emissions are associated with solvent extraction of the dredged sediments; therefore, human health and the environment would be protected. No possibility of generating toxic gases. Air pollution controls utilized on the thermal treatment equipment would be protective of human health and the environment.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
8. Excavation/Treatment/ Containment	Protection and remedial action objectives achievable within 10 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effective treatment of the extracted ground water would be achievable pending construction and shakedown of the required treatment system and equipment. The timeframe for this component includes 19 months for engineering design and construction following issuance of a permit to install. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years. It is assumed that in-situ soil flushing would operate for 10 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and the interceptor wells.	Would not adversely impact the health or safety of the community during construction. Regrading of the CMSD, and the former disposal ponds, dredging of the sediments in the Outfall 004 backwater area, and excavating of the carbonaceous material in the CRDA and placement in the CMSD prior to capping could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
9.Excavation/Treatment/ Off-Site Disposal	Protection and remedial action objectives achievable within 12 to 14 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effectiveness of treatment on ground water from new interceptor wells would be determined through extensive treatability testing. Timeframe for treatability testing, system design, and construction is on the order of 2 to 3 years. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. Excavation of the 4000 CY of soil from the former spent potliner storage area could be implemented in 1 to 2 years. Solidification of the pond solids would require approximately 1 to 2 years. Solidification of the excavated sediments from Outfall 004 backwater area could be very short. Excavation and off-site landfill disposal of soils from the area of greater relative cyanide concentration in the former spent potliner area, the carbonaceous materials from the carbon run-off and deposition area, and the sediments could potentially be achieved within two years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well. Excavation and off-site landfill disposal of the soil from the area of greater relative cyanide concentration in the former spent potliner storage area and the carbonaceous material from the carbon run-off and deposition area would be reliable over the short-term. Operational controls utilized for the dredging operations would be effective in the short-term.	Would not adversely impact the health or safety of the community during construction. Regrading of CMSD, former spent potliner storage area, and the former disposal ponds, solidification of the solids in the former disposal ponds and sediments, and the excavation of the carbonaceous material could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal. Silt curtains and sheet piling utilized as operational controls will aid in protecting the community during dredging operations. Air pollution controls utilized on the thermal treatment equipment would be protective of human health and the environment.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

Table 7-3 (Contined) - Comparison of Short Term Effectiveness

REMEDIAL ALTERNATIVE	TIME UNTIL PROTECTION IS ACHIEVED	SHORT-TERM RELIABILITY	COMMUNITY PROTECTION	WORKER PROTECTION
10.Containment	Protection and remedial action objectives achievable within 2 - 4 years of remedy selection. Containment of ground-water plume would be achievable immediately. Effectiveness of treatment on ground water from new interceptor wells would be determined through extensive treatability testing. Timeframe for treatability testing, system design, and construction is on the order of 2 to 3 years. Solidification of the pond solids prior to capping would require approximately 1 to 2 years. Design and implementation of the collection trench and treatment equipment for the CMSD seeps could be potentially completed within 1 to 2 years. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection. Protectiveness associated with the capping components would be achievable within 2 to 3 years.	Would be reliable in the short-term. Containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well.	Would not adversely impact the health or safety of the community during construction. Regrading of CMSD, former spent potliner storage area, and the former disposal ponds, dredging of the sediments in the Outfall 004 backwater area and the river, and the excavation of the carbonaceous material from the CRDA and placement in the CMSD prior to capping could potentially result in airborne emissions of dust and other substances. These emissions would be effectively controlled by operational practices. No possibility of generating toxic gases. Ground water would continue to be discharged to the Ohio River via Outfall 004, however, river water is not used for drinking water purposes and recreational uses in the vicinity of the 004 outfall are minimal.	Workers would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized. Operational controls would be established during the construction period.

actual timeframe for achieving protection under Remedial Alternatives may be significantly different from the 10-year timeframe assigned in this FS.

Remedial Alternatives 6, 7, and 9 would achieve protection of human health and the environment and remedial response objective of blocking direct exposure pathways, in a timeframe greater than 10 years. These timeframes largely result from the prolonged period required for thermal treatment of the materials in the CMSD, followed by containment of the treatment residuals. In the case of Remedial Alternative 9, the timeframe is further extended by the need to solidify the former disposal ponds prior to treatment of the CMSD. Similarly, under Remedial Alternative 6, the timeframe is further extended by the need to stabilize and cover the former disposal ponds prior to treatment of the material in the CMSD.

Under Remedial Alternatives 2 through 10, containment of the ground-water plume would be achieved immediately, as these alternatives would utilize the existing Ormet Ranney well and either the existing or new interceptor wells. Under Alternatives 2 through 8, effective treatment of the ground water extracted by the existing interceptor wells could be achievable within 19 months following issuance of a PTI. Under Alternatives 9 and 10, treatment of the ground water pumped by the new interceptor wells installed closer to the source may not be achievable for a period of 2 to 3 years. This is due to the need to conduct extensive treatability testing to evaluate the ability to meet NPDES effluent limits. Design and implementation of the collection trenches and treatment system for the CMSD seeps could potentially be completed within 1 to 2 years.

Remedial Alternatives 3 through 10 include partial or complete dredging of the sediments as components of these alternatives. The potential need for administrative approvals concerning dredging activities may extend the timeframe for achieving protection under these alternatives.

Since Remedial Alternative 1 involves the absence of active remedial measures, protection of human health and the environment or remedial response objectives would not be achieved in the foreseeable future.

7.3.2 Short-Term Reliability

Remedial Alternatives 2 through 10 would be reliable in the short-term. Under each of these alternatives, containment of the ground-water plume would be performed through continued pumping of the Ormet Ranney well and existing or new interceptor wells. The ground-water containment system at the site has operated reliably since installation of the Ranney well, and would continue to do so in the short-term under Alternatives 2 through 9.

Operational controls that would be instituted during dredging operations under Remedial Alternatives 3 through 10 would be effective in the short-term for minimizing the transport of resuspended sediments. Since Remedial Alternative 1 involves the absence of active remedial measures, there are no short-term reliability considerations associated with this Alternative.

7.3.3 Community Protection

Remedial Alternatives 2 through 10 would not adversely impact the health or safety of the community during construction or long-term operations. There is no possibility that implementation of Alternatives 2 through 10 would generate toxic gases. Ground-water treatment would be performed at alkaline pH. Therefore, the generation of HCN gas is not possible. None of the other treatment or containment components of these alternatives would result in the possible generation of toxic reaction by-products. Earthmoving and other material handling activities associated with these alternatives could potentially result in airborne emissions of dust and other substances. These emissions would be effectively minimized through operational controls (i.e., dust suppression) that would be instituted under each of these alternatives. Ground water would continue to be discharged to the Ohio River via Outfall 004 pending construction and shakedown of a treatment system under Alternatives 2 through 10. River water is not used for drinking purposes and recreational uses in the vicinity are limited. Therefore, this component of Alternatives 2 through 10 would not adversely impact the health or safety of the community over the short-term. Remedial Alternative 1 would not result in an increased level of protection of the community over the short-term.

7.3.4 Ecological Protection

The containment and/or treatment strategies in Remedial Alternatives 2 through 10 would preclude or significantly limit exposure on-site. Dredging or dredging and containment of the sediments in Alternatives 3 through 10 would eliminate or significantly reduce the potential direct exposure to the sediments or release of constituents from the backwater sediments. These alternatives would temporarily disrupt benthic habitat in the backwater area. However, ecological protection would be achieved through resedimentation and associated restoration of the benthic habitat.

Remedial Alternative 1 would not provide any ecological protection because no containment or treatment options would be employed.

7.3.5 Worker Protection

Remedial Alternatives 2 through 10 would be protective of workers during remedial implementation. Under each of these alternatives, on-site construction and operational personnel would require training and medical monitoring in accordance with 29 CFR 1910.120. Protective clothing and respiratory equipment as specified in a site-specific health and safety plan would be utilized under Alternatives 2 through 10. Operational controls would also be established during the construction period for each of these alternatives.

Since Remedial Alternative 1 involves the absence of active remedial measures, there would be no on-site construction or operational workers. Consequently, there are no worker protection considerations associated with this remedial alternative.

7.4 Long-Term Effectiveness

The effectiveness of each remedial alternative over the long term is compared in this Section. Table 7-4 presents a summary of the comparative analysis of long-term effectiveness considerations. As discussed throughout Section 6, the various cap configurations would be effective in reducing infiltration through the underlying media. The performance of the cap configurations as indicated by infiltration modelling is summarized in Table 7-5. In general, infiltration modelling predicts that the performance of the single barrier synthetic caps would be comparable to that of the double barrier caps, with single barrier clay caps being slightly less effective. Infiltration modelling also predicted that site grading and construction of vegetated soil covers would perform well in reducing infiltration over existing conditions.

Remedial Alternatives 2 through 8 utilize ground-water remedial measure GW-3, which includes continued operation of the Ormet Ranney wells and existing interceptor wells to control and recover the plume. Remedial Alternatives 9 and 10 utilize the Ormet Ranney well and new interceptor wells installed closer to the source. As summarized in Section 6 and described in greater detail in Appendix K, the time that may be required to reduce the concentration of total cyanide in ground water pumped by the respective sets of interceptor wells to 0.1 mg/L has been roughly project to be 25 years, under current site conditions. With regard to that portion of the alluvial aquifer immediately downgradient of the FSPSA, it is projected that operation of the existing interceptor wells will reduce total cyanide concentrations to or below the MCL in 38 years, under current site conditions. Operation of interceptor wells placed closer to the source (GW-5) is projected to result in the reduction of total cyanide concentrations at the pumping

Table 7-4 - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
1. No Action	Reduction of assumed existing risks would not be addressed over the long-term.	Would be as calculated under the hypothetical future use scenarios described in the Baseline Risk Assessment.	No long-term reliability considerations.	Future exposures under actual or hypothetical site use scenarios would not be prevented.	No potential replacement considerations.
2. Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by the vegetated soil covers and the sheet piling and concrete revetments over the sediments in the Outfall 004 backwater area. Institutional controls would ensure the effectiveness of these measures for sediment. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would effectively collect the seeps. Vegetated soil covers would prevent the emission of fugitive dust, eliminate direct contact exposure to the impacted media, and reduce infiltration. Placement of concrete revetments would prevent exposure to hypothetical trespassers or future residents. Food chain exposures would be eliminated.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Vegetated soil covers would be reliable over the long-term. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Placement of the vegetated soil cover and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low. Potential for repair of the vegetated soil covers would be limited to periodic maintenance.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
3. Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by the single barrier synthetic caps and the concrete revetments over the sediments in the Outfall 004 backwater area. Institutional controls would ensure the effectiveness of these remedial measures for sediment. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would effectively collect the seeps. Single barrier synthetic caps would reduce potential transport, infiltration, and seep generation. Pumping of the alluvial ground water would preclude future exposure to the ground water. Dredging and containment of the sediments in the Outfall 004 backwater area would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Long-term reliability of single barrier caps utilizing synthetic membrane materials of construction has been proven, dependent upon adequate post-closure maintenance. Vendor literature indicates that materials used for concrete revetments are reliable over the long-term. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield and CMSD seeps. Capping with single barrier synthetic caps and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low.Potential for repair of single barrier caps utilizing synthetic membrane materials of construction would be limited to periodic maintenance of the soil cover. Highly durable materials utilized in concrete revetments would not be likely to require replacement over the long-term.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
4. Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by the dual barrier caps and removal of the sediments in the Outfall 004 backwater area. Institutional controls would ensure the effectiveness of these remedial measures for sediment. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would effectively collect the seeps. Dual barrier caps would prevent the emission of fugitive dust, eliminate direct exposure to the impacted soils, and can effectively eliminate infiltration and transport. Dredging of sediments in the Outfall 004 backwater area would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Solidified materials are subject to natural weathering. Capping these materials would minimize degradation of the solidified material. Long-term reliability of dual barrier caps has been proven, dependent upon adequate post-closure maintenance. Vendor literature indicates concrete revetments are reliable in the long-term. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Capping with dual barrier caps and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low. Potential for repair of dual barrier caps utilizing bentonite admixture and synthetic membrane materials of construction would be limited to periodic maintenance of the soil cover. Highly durable materials utilized in concrete revetments would not be likely to require replacement over the long-term.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
5. Containment/ Off-Site Disposal	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by the single barrier synthetic caps, the partial removal of soils and the single barrier synthetic cap over the FSPSA, and the concrete revetments over the remaining sediments in the Outfall 004 backwater area. Institutional controls would ensure the effectiveness of these remedial measures for sediment. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would collect the seeps.] Single barrier synthetic caps would prevent the emission of fugitive dust, eliminate direct exposure to the impacted soils, and can effectively eliminate infiltration and transport. Dredging and containment of sediments in the Outfall 004 backwater area would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Long-term reliability of single barrier synthetic caps has been proven, dependent upon adequate post-closure maintenance. No substantial uncertainties identified regarding off-site land disposal of soil from the FSPSA that would require special long-term considerations. Vendor literature indicates concrete revetments are reliable over the long-term. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Capping with single barrier synthetic caps and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low. Potential for repair of single barrier caps utilizing synthetic membrane materials of construction would be limited to periodic maintenance of the soil cover.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
6. Treatment/Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by stabilization of the pond solids and sediments and the vegetated soil cover that would be constructed over the FSPSA, and CMSD, and the concrete revetments over the sediments in the Outfall 004 backwater area. Institutional controls would ensure the effectiveness of these remedial measures for sediment. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would collect the seeps. Single barrier synthetic caps and a vegetated soil cover over the FDPs would prevent the emission of fugitive dust, eliminate direct exposure to the impacted media, and can effectively eliminate infiltration and transport. Dredging and containment of sediments in the Outfall 004 backwater area would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment, treatment of the interceptor well water, and concrete revetments are expected to be reliable. Stabilized materials are subject to natural weathering. Covering the former disposal ponds with a vegetated soil layer would not significantly enhance the long-term reliability. Long-term reliability of single barrier synthetic caps has been proven. No substantial uncertainties regarding off-site land disposal of soil from the FSPSA. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Capping with single barrier synthetic caps, stabilization of the former disposal ponds followed by placement of a vegetated soil cover, and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low. Potential for repair of single barrier caps utilizing synthetic membrane materials of construction would be limited to periodic maintenance of the soil cover.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
7. Treatment/Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by solidification of the pond solids and sediments. The dual barrier synthetic caps and the single barrier cap over the CMSD treatment residuals would also reduce exposure pathways. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would collect the seeps. Single barrier synthetic caps and the dual barrier cap over the FDPs would prevent the emission of fugitive dust, eliminate direct exposure to the impacted soils, and can effectively eliminate infiltration and transport. Dredging and containment of sediments in the Outfall 004 backwater area would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Solidified materials are subject to natural weathering. Dual barrier capping would aid in maintaining long-term reliability. Long-term reliability of dual barrier caps has been proven, dependent upon adequate post-closure maintenance. Long-term reliability of in-situ soil flushing is not known. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Capping with single and dual barrier caps and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low. Potential need to replace the components associated with the in-situ soil flushing system is low due to the relative simplicity of the equipment that would be employed. Potential for repair of dual barrier caps utilizing compacted by and synthetic membrane materials of construction would be limited to periodic maintenance of the soil cover.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
8. Excavation/Treatment/ Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term, through obstruction of potential exposure pathways by the single barrier synthetic caps and the concrete revetments over the remaining Outfall 004 backwater area sediments. Institutional controls would ensure the effectiveness of these remedial measures for sediment. Sediments in the Ohio River addressed through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would effectively collect the seeps. Single barrier synthetic caps would prevent the emission of fugitive dust, eliminated direct exposure to the impacted media, and can effectively eliminate infiltration and transport. Dredging and containment of sediments in the Outfall 004 backwater area would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Long-term reliability of single barrier synthetic caps has been proven, dependent upon adequate post-closure maintenance. Long-term reliability of in-situ soil flushing is not known. Vendor literature indicates that materials used for concrete revetments are reliable over the long-term. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Single barrier synthetic caps over the CMSD and the former disposal ponds would reduce potential infiltration and transport of constituents to the ground water. The future single barrier cap coupled with the sand barrier that would be placed over the former spent potliner storage area following completion of in-situ soil flushing would form physical barriers against direct contact.	Potential need to replace the ground-water extraction and treatment components is low. Potential need to replace the components associated with the in-situ soil flushing system is low due to the relative simplicity of the equipment that would be employed. Potential for repair of single barrier caps utilizing synthetic membrane materials of construction would be limited to periodic maintenance of the soil cover. Highly durable materials utilized in concrete revetments would not be likely to require replacement over the long-term.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
9. Excavation/Treatment/ Off-Site Disposal	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by the single barrier synthetic caps, and the dual barrier caps over the FDPs. Sediments in the Ohio River address through natural processes.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would collect the seeps. Dual barrier synthetic caps on the FDPs and the single barrier cap over the FSPSA and the CMSD would prevent the emission of fugitive dust, eliminate direct exposure to the impacted media, and would significantly reduce infiltration and transport of constituents to the ground water. Dredging and off-site landfilling of sediments would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water may be reliable over the long-term. Treatability testing would be required to confirm effectiveness of treatment and to assess reliability. Solidified materials are subject to natural weathering. Capping these materials would aid in maintaining long-term reliability. No substantial uncertainties regarding off-site land disposal that would require special long-term considerations. Long-term reliability of dual barrier caps has been proven. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield or CMSD seeps. Capping with single and dual barrier caps would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration by transport.	Potential need to replace the ground-water extraction and treatment components is low, although interceptor wells placed closer to the source would require frequent maintenance due to scaling. Potential for repair of single and dual barrier caps would be limited to periodic maintenance of the soil cover.

Table 7-4 (Continued) - Comparison of Long-Term Effectiveness

REMEDIAL ALTERNATIVE	REDUCTION OF ASSUMED EXISTING RISKS	MAGNITUDE OF FUTURE RISKS	LONG-TERM RELIABILITY	PREVENTION OF FUTURE EXPOSURE	POTENTIAL FOR REPLACEMENT
10. Containment	Would effectively eliminate the assumed existing human health and environmental risks over the long-term through obstruction of potential exposure pathways by the single barrier compacted clay caps and the removal of sediments in the Outfall 004 backwater area and the river. Institutional controls would ensure the effectiveness of these remedial measures for sediment.	Future hypothetical exposure risks related to potable water would be precluded. Trench drains would effectively collect the seeps. Single barrier clay caps would reduce potential transport, infiltration, and seep generation. Pumping of the alluvial ground water would preclude future exposure to the ground water. Dredging and containment of the sediments in the Outfall 004 backwater area and the river would prevent exposure to hypothetical trespassers or future residents.	Would be reliable over the long-term. Ground-water containment is expected to be highly reliable. Treatment of the interceptor well water would be reliable over the long-term. Long-term reliability of single barrier clay caps has been proven, dependent upon adequate post-closure maintenance. Solidified pond materials may be subject to natural weathering, although capping would reduce effects. A five year review would be required.	Future exposure to the constituents in the ground water would be prevented by pumping and treating. Trench drains would effectively collect the seep water and eliminate possible exposure at the ballfield and CMSD seeps. Capping with single barrier clay caps and installation of concrete revetments would eliminate the potential for direct contact exposure, prevent releases to the air, and can effectively eliminate infiltration and transport.	Potential need to replace the ground-water extraction and treatment components is low, although interceptor wells closer to the source would require frequent maintenance due to scaling. Potential for repair of single barrier caps would be limited to periodic maintenance of the soil cover.

Table 7-5. Comparison of Cap Performance.

CAP TYPE	PERCENT REDUCTION IN INFILTRATION OVER EXISTING CONDITIONS	
	FSPSA	CMSD
Vegetated Soil Cover	32.3%	22.2%
Single Barrier Synthetic Cap	99.5%	99.5%
Single Barrier Clay Cap	97.2%	97.2%
Dual Barrier Cap	99.9%	99.9%

wells to or below the MCL in approximately 36 years, under current site conditions.The various source control measures utilized under Alternatives 3 through 10 would be expected to reduce these times; however, the extent to which aquifer restoration times may be reduced is uncertain.

7.4.1 Reduction of Assumed Existing Risks

Remedial Alternatives 2 through 10 would effectively eliminate the assumed existing human health and environmental risks over the long-term. These reductions would be largely achieved through obstruction of potential exposure pathways by various containment structures that would be implemented under these alternatives. The reduction of existing risks would also be facilitated by the various removal and treatment components under Remedial Alternatives 5 through 10. Hypothetical future risks would also be effectively eliminated through institutional controls prohibiting the installation of on-site drinking water wells and through continued containment of the plume.

Remedial Alternatives 3 through 10 could result in creation of an additional exposure pathway. A greater release of PCBs by volatilization could occur from complete or partial dredging of sediments under these alternatives. Remedial Alternative 2 would not result in this effect, because the sediments in the Outfall 004 backwater area would be contained in place under Remedial Alternative 2.

Remedial Alternative 1 would not result in a reduction of existing risks over the long term.

7.4.2 Magnitude of Future Risks

Future hypothetical human health and environmental exposures will be effectively prevented or eliminated through implementation of Remedial Alternatives 2 through 10. The containment barriers that would be instituted under these alternatives would prevent the fugitive emission of dust and eliminate direct contact exposure to the impacted soils and other media at the site. Grading, used in conjunction with any of the containment measures under Alternatives 2 through 10 would maximize runoff and eliminate standing water. The vegetated soil cover used in Alternatives 2 and 7 would reduce infiltration. The single barrier and double barrier caps utilized in Alternatives 3 through 10 would essentially eliminate infiltration.

Future hypothetical exposure to ground water will be precluded by the containment and treatment of the ground water extracted by the interceptor wells and by the establishment of deed restriction on the property.

The magnitude of future risks under Remedial Alternative 1 would be greater than under Alternatives 2 through 10. The future risks under Remedial Alternative 1 would be as calculated under the hypothetical future use scenarios assumed in the Baseline Risk Assessment.

7.4.3 Long-Term Reliability

Remedial Alternatives 2 through 10 would be reliable over the long-term, because the Ormet site is part of an operating facility with an established security force and maintenance personnel. Ground-water containment under these alternatives is expected to be highly reliable over the long-term, as evidenced by the operating history of the Ormet Ranney well and the interceptor wells. Treatment of the ground water extracted by the interceptor wells would also be reliable under Remedial Alternatives 2 through 8. Although, operational variability, apparently due to the complicated precipitation chemistry of cyanide complexes, was found to be common during pilot studies of the treatment component of ground-water remedial measure GW-3. This operational variability would be exacerbated by ground water pumped from closer to the source under GW-5, due to the different chemical composition of the influent stream. Also, operation of wells closer to the source would require frequent maintenance of the pumps and well screens, due to the high levels of dissolved constituents and the tendency for the dissolved constituents to precipitate and cause scaling of the pumps and well screens. The single barrier and dual barrier caps used in Alternatives 2 through 10 would be reliable over the long term. The reliable life expectancy of a RCRA (i.e., dual barrier) cap and a standard (i.e., single barrier) landfill cap with normal maintenance is approximately 50 to 100 years. Proper QA/QC during construction and routine maintenance can greatly reduce the potential for damage to the caps. The long-term reliability of in-situ soil flushing, under Remedial Alternatives 7 and 8 is not known because this technology has not been applied over the long-term at other sites. The long-term reliability of Remedial Alternative 6 may also be limited because stabilized materials are subject to breakdown due to natural weathering, and containment of the former disposal ponds would not significantly enhance the long-term reliability of this alternative. Since Remedial Alternative 1 involves the absence of active remedial measures, there are no long-term reliability considerations associated with this alternative.

7.4.4 Prevention of Future Exposure

Future exposure to the constituents in the alluvial aquifer will be prevented by continued containment, extraction, and treatment of the alluvial ground water under Alternatives 2 through 10. As discussed in Section 6 and Appendix K, regarding the remediation of ground-water, restoration of ground-water quality will require and extended period of time. Therefore, under the hypothetical future residential use scenario evaluated in the BRA, there would be a potential for exposure to contaminated ground water through an on-site drinking water well until restoration of the aquifer is achieved. The trench drain that would be constructed along the toe of the CMSD and in the ballfield area under these alternatives would also effectively collect the seep water and eliminate potential exposure to the constituents in the seep water. Placement of the containment barriers under these alternatives will also eliminate the potential for direct contact exposure, prevent releases to air, and can effectively eliminate infiltration and transport.

7.4.5 Potential For Replacement

The potential need to replace the ground-water containment and extraction components of Remedial Alternatives 2 through 8 is low. The need to replace components of the new interceptor wells under Alternatives 9 and 10 would be more frequent due to scaling. The potential need to replace components of the treatment system for the interceptor well water is low under Remedial Alternatives 2 through 10. The potential need to repair the containment structures under these alternatives would be limited to periodic maintenance of the soil cover. Periodic maintenance would include checking perimeter fencing, checking for soil subsidence and erosion, control of burrowing animals, and removal of trees. The highly durable materials of construction that would be utilized as concrete revetments under Remedial Alternatives 3, 5, and 8 would not be likely to require replacement over the long-term. Under Remedial Alternatives 7 and 8, the potential need to replace the components associated with in-situ soil flushing would be low due to the relative simplicity of the equipment that would be employed. Since Remedial Alternative 1 involves the absence of active remedial response measures, there are no replacement considerations under the no-action alternative.

7.5 Reduction of Toxicity, Mobility, and Volume

The following section consists of a comparison of the various remedial alternatives with respect to the treatment or destruction of constituents or media that would be achieved under those alternatives.

Toxicity reductions vary among the nine sitewide remedial alternatives. Under Remedial Alternatives 2 through 10, ground water would be extracted by interceptor wells. This would result in removal of constituents from the extracted ground water. The containment component in Remedial Alternatives 2 through 10 would also block potential exposure pathways. For Alternatives 3 through 10 when either a single (clay or synthetic) or double barrier cap is used to cover the CMSD, infiltration would be reduced, thus eliminating or significantly decreasing generation of the seeps. Following capping, the seeps may stop discharging entirely. Remedial Alternatives 6, 7, and 9 include thermal treatment of the materials in the CMSD. Utilizing thermal treatment in these alternatives would result in a decrease in toxicity due to the destruction of constituents in the media. Solvent extraction utilized in Remedial Alternative 7 would also decrease toxicity. This would be due to the subsequent destruction of constituents after their removal from the sediments.

Remedial Alternatives 4, 6, 9 and 10 include solidification of the former disposal ponds. The solidification process included in these alternatives is intended primarily to improve the bearing capacity of the pond sludges. Solidification of the pond sludges may also decrease toxicity of amenable cyanide by forming more stable cyanide complexes. Also, immobilization of other inorganics constituents may be expected as a result of the solidification.

Remedial Alternatives 5, 6, and 9 would require excavation and off-site disposal This would reduce the volume of the constituent at the site, however, would not represent a net volume reduction in the environment. Volumetric increases would result from the solidification and stabilization components associated with Remedial Alternatives 3 through 10.

7.5.1 Quantities Treated or Destroyed

Remedial Alternatives 2 through 10 would include ground-water treatment. Under Alternatives 2 through 8, approximately 0.34 MGD of ground water would be extracted by the existing interceptor wells and treated on-site. Under Alternatives 9 and 10, new interceptor wells placed closer to the source would pump approximately 78,000 GPD for on-site treatment. Approximately 2.7 million gallons per year (or less) of seep water would be treated under these alternatives also.

Under Remedial Alternatives 4, 6, 7, 9, and 10 stabilization/solidification of approximately 420,000 CY of material in the former disposal ponds would be performed.

An estimated 225,000 CY of CMSD material would be thermally treated under Remedial Alternatives 6, 7, and 9. The remaining 12,000 CY of CMSD material anticipated to be too large for thermal treatment would be disposed off-site. Approximately 4,000 CY of carbonaceous material from the CRDA would be thermally treated under Remedial Alternatives 6 and 7.

The total volume of soil in the former spent potliner storage area that would be treated by in-situ soil flushing under Remedial Alternative 7 and 8 is approximately 800,000 CY. Up to approximately 4,000 CY of soil would be excavated and disposed off-site from the former spent potliner storage area under Remedial Alternatives 5, 6, and 9.

Remedial Alternatives 3 through 6, 8, and 9 involve dredging of the sediments from the Outfall 004 backwater area. Up to approximately 2,000 CY of sediments would be dredged from this area followed by solidification. Remedial Alternative 7 would involve dredging of up to approximately 2,000 CY of sediments from the backwater area, followed by solvent extraction. Alternative 10 involves dredging of sediments in the backwater area and the Ohio River immediately downriver of the backwater area to achieve the SQCs for PCBs and PAHs. This would result in the removal of approximately 5,500 CY of sediment.

No media would be treated or destroyed under Remedial Alternative 1.

7.5.2 Degree of Expected Results

Treatment of the ground-water extracted by the existing interceptor wells has been shown to remove cyanide, fluoride, and color. This treatment would be utilized in Remedial

Alternatives 2 through 8. As discussed in Section 3.2.3.3, influent cyanide concentrations of 5.5 to 9.6 mg/l were reduced under carefully controlled pilot plant conditions to effluent concentration of 0.19 to 0.89 mg/L[1]. This corresponds to a cyanide removal efficiency of 90.7 to 96.5 percent. Influent fluoride concentrations of 24 to 34 mg/L were reduced under carefully controlled pilot plant conditions to 10 to 15 mg/L[2]. This corresponds to a fluoride removal efficiency in the range of 55 to 58 percent. Color removal was determined qualitatively by visual observation. Tea colored influent was associated with a clear effluent. The effectiveness of the treatment system using ground water pumped from wells closer to the source under Alternatives 9 and 10 would need to be evaluated through extensive treatability testing.

Oil/water separation for the CMSD seeps under Remedial Alternatives 2 through 10 could achieve an effluent oil and grease concentration of 10 mg/l. Dissolved PCBs, if any, present in the separator effluent would be removed by activated carbon adsorption under these alternatives. Activated carbon is highly efficient for removing PCBs.

Remedial Alternatives 7 and 8 include in-situ soil flushing. The degree of expected reductions in constituent concentration that would result from this technology are not known due to the limited data available on this technology. Studies have shown that in-situ soil flushing, is most effective in highly permeable soils with low organic content. Based on the RI report, the former spent potliner storage area may meet these criteria. Therefore, this technology may result in significant reductions for soluble soil constituents.

Thermal treatment of material from the CMSD for Remedial Alternatives 6, 7, and 9 would yield significant concentration reductions for organics and cyanide present in the CMSD. Similarly, thermal treatment would be utilized for material from the CRDA under Remedial

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[1]Baker/TSA, Inc., 1990.

[2]Baker/TSA, Inc., 1990.

Alternatives 6 and 7. A DRE of 99.99% could be achieved for these substances using a transportable rotary kiln incinerator.

Stabilization/solidification of the former disposal ponds under Remedial Alternatives 4, 6, 7, 9, and 10 would be achieved using a pozzolanic material, such as lime or fly ash. The lime and lime/flyash processes are able to accommodate large quantities of organics, as well as inorganic sludges[3].

7.5.3 Permanence of Treatment

Cyanide and fluoride precipitation utilized in the ground-water treatment system for Remedial Alternatives 2 through 10 is a permanent treatment. Cyanide and fluoride would be precipitated into a sludge and the sludge would be removed from the system and disposed off-site.

Treatment of the CMSD seeps by oil/water separation also utilized in Remedial Alternatives 2 through 10 is also a permanent treatment. The treatment residuals from this treatment process would include free-phase oil and spent activated carbon that may contain PCBs. Therefore, once these residuals have been removed from the site, these constituents could not recontaminate the CMSD seeps after being treated.

Implementation of Remedial Alternatives 4, 6, 7, 9, and 10 would include stabilization/solidification. Additionally the sediments from the Outfall 004 backwater area would be stabilized under Remedial Alternatives 3 through 6, 8, and 9. Stabilization of the pond solids and sediments may cause an increase in the pH of the materials. This would have little or no impact on the mobility of the constituents of concern. The pH of the pond solids is

[3]Conner, 1990.

already in the 8 to 10 range, where the mobility of metals is low, and would not be expected to decrease below this range if the stabilized material began to deteriorate. Because the pond solids are a carbonaceous material, PAHs are tightly bound and relatively immobile. Stabilization of the pond solids would not substantively effect this current condition. With regard to sediments, the primary constituents of concern are PCBs and PAHs, which tend to adsorb to soil particles. Stabilization of the sediments, and the associated increase in pH, would not be expected to substantively effect the mobility of PAHs and PCBs.

Natural weathering can cause the solidified materials to physically disintegrate as mechanical strength is reduced through chemical reactions. Standards have not been established for performing durability tests on solidified materials. However, a 15 percent weight loss is considered to be acceptable[4]. The dual barrier caps under Remedial Alternatives 4, 7, and 9 should aid in preventing these problems. The vegetated soil cover that would be provided for the ponds under Remedial Alternative 6 would also aid in preventing problems, although to a lesser degree than a single or dual barrier cap.

Thermal destruction of the organics and cyanide present in the CMSD under Remedial Alternatives 6, 7, and 9 is an irreversible process. This is similar for the thermal treatment of the CRDA material under Remedial Alternatives 6 and 7. Thermal treatment would destroy organics forming simple inorganics such as carbon dioxide and water.

Solvent extraction of the organics present in the Outfall 004 backwater area sediments under Remedial Alternative 7 is also a permanent treatment method. The PAHs and PCBs present in the sediment would be permanently removed. Additionally, thermal treatment of the organic liquid residual would permanently destroy these constituents.

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[4]USEPA, 1989i.

7.5.4 Treatment Residuals

Treatment residuals from the lime/ferrous salt precipitation component of Remedial Alternatives 2 through 10 consists of dewatered sludge. Baker/TSA, Inc. estimated that full scale operation using ground water pumped from the existing interceptor wells would yield approximately three tons per day of dewater sludge (filter cake)[5]. For the ground water post-treatment measure under Remedial Alternatives 9 and 10 the residues resulting from activated alumina adsorption would consist of an aqueous solution of sodium chloride and sodium fluoride. Mass balance calculations indicated that approximately 88,000 gallons of these regeneration wastes would be produced per regeneration cycle. This equates to approximately 3,608,000 gallons per year. Extensive treatability testing would need to be performed to determine the effectiveness of the treatment system and the character of the residuals using ground water from wells placed closer to the source under Alternatives 9 and 10.

Treatment residuals would also be associated with treatment of the collected seep water from the CMSD seeps under Remedial Alternatives 2 through 10. These residuals would include free-phase oil from the oil/water separator and spent activated carbon from the adsorber vessels. The amount of free-phase oil observed on the CMSD during the RI was limited to a light sheen. Consequently, the amount of oil resulting from implementation of these alternatives would be minimal. As discussed in Section 5, it was assumed that three containers of activated carbon would be expended quarterly. This equates to approximately 4,800 pounds per year (at 400 pound per container).

Stabilization/solidification of the pond solids under Remedial Alternatives 4, 6, 7, and 10 and the sediments dredged under Remedial Alternatives 3 through 6, 8, 9, and 10 will also

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[5]Baker/TSA, Inc., 1990.

generate treatment residuals. The stabilized/solidified materials will increase from 30 to 50 percent by volume, resulting in 553,000 to 637,000 (Table 6-13).

Thermal treatment of the CMSD under Remedial Alternatives 6, 7, and 9 and similarly for the CRDA materials under Remedial Alternatives 6 and 7 would result in treatment residuals of any materials that would not combust. Based on visual observation during test pit excavations in the CMSD, the material to be treated consists largely of fire-brick, steel, some wood and other construction and demolition debris. Due to the nature of this material, it is estimated that only minimal volume reduction (i.e., 10 to 20 percent) will occur during thermal treatment. The material to be excavated from the CRDA consists almost exclusively of carbonaceous material (i.e., spent anode comprised of calcined coke). Therefore, a volume reduction of 90 percent or greater would be anticipated during thermal treatment of the carbonaceous material excavated from the CRDA.

Treatment residuals would also be generated by the solvent extraction of the dredged sediments under Remedial Alternative 7. These residuals would include:

- organic liquid containing PAHs and PCBs;
- water containing dissolved inorganics; and
- solids containing inorganics.

The vendor of this technology indicated that the quantity of organic liquids would be approximately 40 CY. This equates to 150 55-gallon drums of organic liquid residuals. The quantity of water resulting from this treatment process varies depending upon the water content of the material being treated. The quantity of residual solids would be approximately, 2,000 CY.

Remedial Alternative 1 has no treatment residuals associated with it.

7.6 Implementability

The implementability of each remedial alternative is compared in this Section. Table 7-6 presents a summary of the comparative analysis of implementability considerations.

7.6.1 Constructability and Operability

Remedial Alternatives 2 through 10 are constructable and operable within site conditions. There are no construction considerations for the ground-water containment system utilized in these alternatives, since the Ormet Ranney well and the current interceptor wells are existing features on-site and new interceptor wells could be installed closer to the source under Alternatives 9 and 10. Construction of the capping components over the former disposal ponds under Alternatives 4, 7, 9, and 10 may pose engineering difficulties related to the need to solidify the disposal pond solids prior to construction of dual barrier or compacted clay caps. Treatability studies would be required for the treatment components under these alternatives to determine proper mixing ratios, levels of removal, ultimate analysis, etc.

Remedial Alternatives 4, 6, 7, 9, and 10 are operable within site conditions however, these alternatives pose certain constructability problems. These alternatives include stabilization/solidification of the materials in the former disposal ponds. Treatment of the Pond 5 solids would require clamshell or dragline equipment. Access would be difficult using this equipment along the berm of Pond 5 bordering the Ohio River. However, proper sequencing and approach to performing this component could overcome the access difficulties.

Remedial Alternatives 6, 7, and 9 pose space requirement difficulties, since they include thermal treatment of the CMSD. Sufficient space is not available for storage pads for pre-

Table 7-6 - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
1. No Action	No constructability and operability issues.	Not applicable.	Limited effectiveness could be monitored through the use existing monitoring wells over the short-term; however this would not be effective for long-term monitoring of off-site migration.	Approvals would not be needed.	Off-site transportation and disposal services would not be needed.	Specialized equipment and skilled workers would not be needed.
2. Containment	Constructable and operable within site conditions. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. No operability considerations associated with containment components. Construction of the vegetated soil covers over the former disposal ponds would not pose undue engineering difficulties.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. Permit-to-Install (PTI) would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would not be required for the installation of the vegetated soil covers for the former spent potliner storage area, the former disposal ponds, and the CMSD. Skilled workers and specialized equipment would not be required for the installation of concrete revetments.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
3. Containment	Constructable and operable within site conditions. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. Construction of the single barrier synthetic caps over the former disposal ponds would not pose undue engineering difficulties. No operability considerations associated with containment components. The sediments from Outfall 004 backwater area could potentially be dredged using commonly available earthmoving equipment.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would be required for the installation of the single barrier synthetic caps. The required materials and services are available through a variety of sources. Skilled workers would not be required for the installation of the concrete revetments. Specialized equipment would be required for steel sheet piling installation.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
4. Containment	Operable within site conditions; however, poses certain constructability problems. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. The solidification of Pond 5 will require clamshell or dragline equipment to ensure adequate reach for mixing the contents with solidifying agents. Access would be difficult using this type of equipment along the berm of Pond 5 bordering the Ohio River. Solidification will be performed from the side adjacent to the former spent potliner storage area toward the river. The sediments from Outfall 004 backwater area could potentially be dredged using commonly available earthmoving equipment. No operability considerations associated with the dual barrier caps and sheet piling containment components.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would be required for solidification of the pond solids and the sediments. This service is commercially available. Specialized equipment and skilled workers would be required for the installation of the dual barrier caps. Specialized welding equipment and qualified operators would be required for the installation of the synthetic membrane barrier layer. The required materials and services are available through a variety of sources. Skilled workers would not be required for installation of concrete revetments. Specialized equipment would be required for steel sheet piling installation.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
5. Containment/Off-Site Disposal	Constructable and operable within site conditions. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. Commonly available earthmoving equipment would be used for the excavation of the soils from the former spent potliner storage area. The sediments from Outfall 004 backwater area could potentially be dredged using commonly available earthmoving equipment. Construction of the single barrier synthetic caps over the former disposal ponds would not pose undue engineering difficulties under this remedial alternative. No operability considerations associated with the containment components.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program.Approval would be required for dredging any sediments not located on Ormet Corporation's property. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for a maximum of 4,000 CY of soil from the former spent potliner storage area. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would not be required for the partial excavation of soils from the former spent potliner storage area. Specialized equipment and skilled workers would be required for the installation of the single barrier synthetic caps. The required materials and services are available through a variety of sources. Skilled workers would not be required for installation of concrete revetments. Specialized equipment would be required for steel sheet piling installation.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
6. Treatment/Containment	Operable within site conditions; however, poses certain constructability problems. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. The stabilization of the solids within Pond 5 will require clamshell or dragline equipment to ensure adequate reach for mixing the contents with stabilizing agents. Access would be difficult using this type of equipment along the berm of Pond 5 bordering the Ohio River. Stabilization will be performed from the side adjacent to the former spent potliner storage area toward the river. Commonly available earthmoving equipment would be used for the excavation of the soils from the former spent potliner storage area and for dredging of the sediments from the Outfall 004 backwater area. Sufficient space is not available for storage pads for pre-processing of the material from the CMSD prior to thermal treatment. No operability considerations associated with the containment components.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program. Approvals would not be required for thermal treatment, however, a trial burn would need to be conducted to determine emissions and operating conditions for the incinerator. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the 4,000 CY of excavated soil from the former spent potliner storage area. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would be required for stabilization of the pond solids and the sediments. This service is commercially available. Specialized equipment and skilled workers are not required for partial excavation of soils from the former spent potliner storage area. Specialized equipment would be required for thermal treatment. Specialized equipment and skilled workers would be required for the installation of the caps. The required materials and services are available through a variety of sources. Skilled workers would not be required for the installation of concrete revetments. Specialized equipment would be required for the installation of sheet piling.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
7. Treatment/Containment	Operable within site conditions; however, poses certain constructability problems. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. Construction of the solvent extraction process equipment would be difficult due to the insufficient space in the vicinity of the sediments. The solidification of the solids within Pond 5 will require clamshell or dragline equipment to ensure adequate reach for mixing the contents with solidification agents. Access would be difficult using this type of equipment along the berm of Pond 5 bordering the Ohio River. Solidification will be performed from the side adjacent to the former spent potliner storage area toward the river. The sediments from Outfall 004 backwater area could potentially be dredged using commonly available earthmoving equipment. Sufficient space is not available for storage pads for pre-processing of the material from the CMSD prior to thermal treatment. No operability considerations associated with the containment components.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE. Approvals would not be required for thermal treatment, however, a trial burn would need to be conducted to determine emissions and operating conditions for the incinerator. Approvals would not be required for solvent extraction of the dredged sediments. No air permits required because no air emissions are generated.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available. Off-site transportation and disposal would be required for the organic liquids from solvent extraction of the dredged sediments. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would be required for solidification of the pond solids and the sediments. This service is commercially available. Specialized equipment is required for thermal treatment of the CMSD and carbonaceous material from the carbon run-off and deposition area. This equipment is commercially available. Specialized treatment equipment is required for solvent extraction of the dredged sediments. This equipment is commercially available. Specialized equipment and skilled workers would be required for the installation of the single and dual barrier caps. The required materials and services are available through a variety of sources. Specialized equipment and skilled workers would not be required for in-situ soil flushing. Specialized equipment would be required for installation of steel sheet piling.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
8. Excavation/Treatment/ Containment	Operable within site conditions; however, poses certain constructability problems. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. Construction of the single barrier caps over the former disposal ponds would not pose undue engineering difficulties. No operability considerations associated with the containment components. The sediments from Outfall 004 backwater area could potentially be dredged using commonly available earthmoving equipment.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would be required for discharges to surface-water under the NPDES program. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Skilled workers and specialized equipment would not be required for implementation of in-situ soil flushing. Specialized equipment and skilled workers would be required for installation of the single barrier caps. The required materials and services are available through a variety of sources. Skilled workers and specialized equipment would not be required for installation of concrete revetments. Specialized equipment would be required for installation of steel sheet piling.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
9. Excavation/Treatment/ Disposal	Potentially operable within site conditions; however, poses certain constructability problems. No construction considerations for the ground-water containment system because the Ormet Ranney well and the interceptor wells are existing features on-site. Operational variability of ground-water treatment system would be exacerbated due to chemical composition of ground water pumped by new interceptor wells. The solidification of the solids within Pond 5 will require clamshell or dragline equipment to ensure adequate reach for mixing the contents with solidification agents. Access would be difficult using this type of equipment along the berm of Pond 5 bordering the Ohio River. Solidification will be performed from the side adjacent to the former spent potliner storage area toward the river. Commonly available earthmoving equipment would be used for the excavation of the soils from the former spent potliner storage area and for dredging the sediments from the Outfall 004 backwater area. Sufficient space is not available for storage pads for pre-processing of the material from the CMSD prior to thermal treatment. No operability considerations containment components.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Ability to obtain approvals required for discharges to surface-water under the NPDES program is unknown due to uncertainty regarding effectiveness of treatment on ground water from new interceptor wells. Dredging or bank improvements along the edge of the Ohio River and Outfall 004 backwater area may require approval from USACOE. Approvals would not be required for thermal treatment, however, a trial burn would need to be conducted to determine emissions and operating conditions for the incinerator.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process and for the activated alumina regeneration wastes. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal would be required for the excavated carbonaceous material from the carbon run-off and deposition area and the 4,000 CY from the former spent potliner storage area. Adequate disposal capacity if available for these materials. Off-site transportation and disposal would be required for the 2,000 CY of solidified sediments from the Outfall 004 backwater area. Adequate disposal capacity if available for these materials. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment would be required for the installation of steel sheet piling. Specialized equipment and skilled workers would be required for solidification of the pond solids and the sediments. This service is commercially available. Specialized equipment and skilled workers would not be required for the partial excavation of soils from the former spent potliner storage area. Specialized equipment and skilled workers would be required for the installation of the single and dual barrier caps. The required materials and services are available through a variety of sources. Specialized equipment would be required for thermal treatment of the materials in the CMSD. Skilled operators would be required for the proper operation of this system.

Table 7-6 (Continued) - Comparison of Implementability

REMEDIAL ALTERNATIVE	CONSTRUCTABILITY AND OPERABILITY	ABILITY TO PHASE INTO OPERABLE UNITS	ABILITY TO MONITOR EFFECTIVENESS	ABILITY TO OBTAIN APPROVALS	ABILITY OF OFF-SITE SERVICES AND CAPACITY	AVAILABILITY OF EQUIPMENT AND SPECIALISTS
10. Containment	Potentially operable within site conditions, however, poses certain constructability problems. No construction considerations for the ground-water containment system because the Ormet Ranney well is an existing feature on-site. Operational variability of ground-water treatment system would be exacerbated due to chemical composition of ground water pumped by new interceptor wells. The solidification of the pond solids would require clamshell or dragline equipment to ensure adequate reach for mixing. Access for this equipment along the berm of pond 5 bordering the Ohio River would be difficult. No operability considerations associated with containment components. The sediments from Outfall 004 backwater area and river could potentially be dredged using commonly available equipment.	Provides opportunities for phasing remediation. Several of the component measures must be implemented sequentially.	Could be effectively monitored through the use of existing network of ground-water monitoring wells. The wells would be effective for periodic sampling to monitor plume distribution and constituent concentrations. The collection trenches for the CMSD and ballfield seeps would provide the opportunity to monitor the flowrate of the seeps. The discharge from the ballfield collection trench and the CMSD seep treatment system would be utilized to monitor the chemical composition and concentrations of the discharges. Additional remedial action could be instituted if monitoring indicated that such action are needed.	Approvals would be required for implementation. PTI would be required to construct the ground-water treatment system. PTI may be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Ability to obtain approvals would be required for discharges to surface-water under the NPDES program is unknown due to uncertainty regarding effectiveness of treatment on ground water from new interceptor wells. Dredging or bank improvements along the edge of the Ohio River may require approval from USACOE.	Off-site transportation and disposal services would be required for the sludge from the lime/ferrous salt precipitation process. Adequate disposal capacity is commercially available for this material. Off-site transportation and disposal services would be required for the free-phase oil from the treatment of the CMSD seeps. The free-phase oil would be handled by off-site facilities for incineration. Adequate disposal capacity is commercially available. Off-site transportation and disposal services would be required for the spent activated carbon. The carbon would be handled by off-site facilities for landfill disposal or incineration. Adequate disposal capacity is available.	Skilled workers and specialized equipment are not required for the ground-water extraction and treatment components. Trained operators would be required for the ground-water treatment equipment and the CMSD seep treatment system. Specialized equipment and skilled workers would be required for solidification of the pond solids and the installation of the single barrier synthetic caps. The required materials and services are available.

processing of the CMSD materials prior to thermal treatment. Remedial Alternative 6 also poses space difficulties due to the space required for the treatment equipment for solvent extraction of the sediments.

Since Remedial Alternative 1 involves the absence of active remedial response actions, there are no constructability and operability considerations associated with the no-action alternative.

7.6.2 Ability to Phase Into Operable Units

Remedial Alternatives 2 through 10 include components that can be managed as operable units. Several of the component measures must be implemented sequentially. Remedial Alternatives 3 through 10 would require stabilization/solidification of the pond solids and/or dredged sediments prior to containment or off-site disposal. Since Remedial Alternative 1 is a no-action alternative, ability to phase into operable units does not apply.

7.6.3 Ability to Monitor Effectiveness

Remedial Alternatives 2 through 10 would provide the ability to monitor the effectiveness of these alternatives. Plume distribution and concentration of constituents in the alluvial aquifer could be effectively monitored using existing on-site monitoring wells. Periodic ground-water monitoring data will also provide the best means of adjusting projections of the time required to achieve reductions in contaminant concentrations in the alluvial aquifer. Additionally, seep collection trenches could be used to monitor flow rate and chemical composition of seep discharges to determine the effect of each remedial alternative. Cap inspections would be performed quarterly to monitor the integrity of the cap barrier. Inspections would include checking for differential settlement or soil subsidence, erosion, leachate outbreaks, surface water ponding and stressed vegetation. For Alternatives 3, 5, and 8 where concrete revetments are used, periodic inspections would be performed to ensure that no shifting or cracking of the revetment has occurred.

Additional remedial action could be instituted for Alternatives 2 through 10 if monitoring indicates that such actions are needed. However, where treatment systems are utilized, modifications to the systems would be difficult to implement. If the area is treated and capped, further remedial action would be difficult due to increased volume and treatment residual composition.

The effectiveness of Remedial Alternative 1 could be monitored through the use of on-site monitoring wells. However, this would not be effective for long-term monitoring of off-site plume migration.

7.6.4 Ability to Obtain Approvals

Remedial Alternatives 2 through 10 would require a permit-to-install (PTI) for the construction of the ground-water treatment system. A PTI may also be required for the CMSD seep collection and treatment system and for the ballfield seep collection system. Approvals would also be required for the discharges to surface-water under the NPDES program under these alternatives.

Remedial Alternatives 3 through 10 each employ either partial or full dredging of sediments. Dredging of this nature will require permitting from the U.S. Army Corp. of Engineers and the USEPA.

No permits or approvals would be required for thermal treatment of CMSD materials under Remedial Alternatives 6, 7, or 9. However, a trail burn would have to be conducted to determine incinerator emissions and operating conditions.

Remedial Alternative 1 would not require approvals for its implementation.

7.6.5 Ability of Off-Site Services and Capacity

Remedial Alternatives 2 through 10 require off-site transportation and disposal services for the treatment residuals from the ground-water treatment component. Off-site transportation and disposal services are available for the sludges produced during the ground-water treatment component of these alternatives. Off-site transportation and disposal services would also be required for the regeneration wastes under Remedial Alternatives 9, and 10. Similarly, adequate transport and disposal opportunity exists for the free-phase oil from the CMSD and ballfield seeps and the spent activated carbon used to treat seep discharges.

Remedial Alternatives 5, 6 and 9 include off-site transportation and disposal of 4000 CY of soil from the FSPSA. Adequate transport and disposal capacity is available for this material. Remedial Alternative 7 will require off-site incineration of residual organic liquids generated during the solvent extraction. Adequate disposal capacity for this material does exist.

Remedial Alternative 1 would not require off-site transportation and disposal services.

7.6.6 Availability of Equipment and Specialists

This section will compare the availability of specialized equipment and skilled workers for each remedial alternative.

7.6.6.1 Specialized Equipment

Remedial Alternatives 3 through 9 would require specialized welding equipment for construction of the synthetic membranes for the single and dual barrier caps. This equipment is commercially available.

Remedial Alternatives 4, 6, 7, 9, and 10 employ solidification of the materials in the former disposal ponds and of the dredged sediment before containment. Specialized equipment will be required for this procedure. This equipment is commercially available.

Remedial Alternatives 3 through 10 include partial or complete dredging of sediments. Specialized equipment will be required to install steel sheet piling to be used as an operational control during dredging.

Remedial Alternatives 6, 7, and 9 require specialized incineration equipment for thermal treatment of the materials in the CMSD and of the carbonaceous material excavated from the CRDA. In addition, specialized separation and crushing equipment such as hammermills or tub-grinders will be required to prepare the CMSD materials for thermal treatment. The incineration equipment and processing equipment are available from a variety of sources.

Remedial Alternative 7 required specialized treatment equipment for the solvent extraction of the dredged sediments. This equipment can be provided by solvent extraction process vendors.

7.6.6.2 Specialized Personnel

Remedial Alternatives 2 through 10 would require trained operators for the ground-water treatment systems and seep collection systems. Remedial Alternatives 3 through 10 would require specialized personnel to install the single and dual barrier caps. These personnel are available through a variety of sources. Remedial Alternatives 4, 6, 7, 9, and 10 would require skilled workers for the stabilization/solidification of FDP solids and dredged sediments. These specialized personnel are also commercially available.

7.7 Cost

This section consists of a cost comparison among the nine remedial alternatives. Each alternative was compared in terms of their capital cost, operations and maintenance (O&M) cost, and overall present worth. The costs associated with each of the remedial alternatives are summarized in Table 7-7.

7.7.1 Capital Cost

The capital cost analysis consisted of estimating individual costs for the implementation of the various remedial measures that make up each remedial alternative. Capital cost figures also include allowances for the cost of engineering/design, construction management and a contingency.

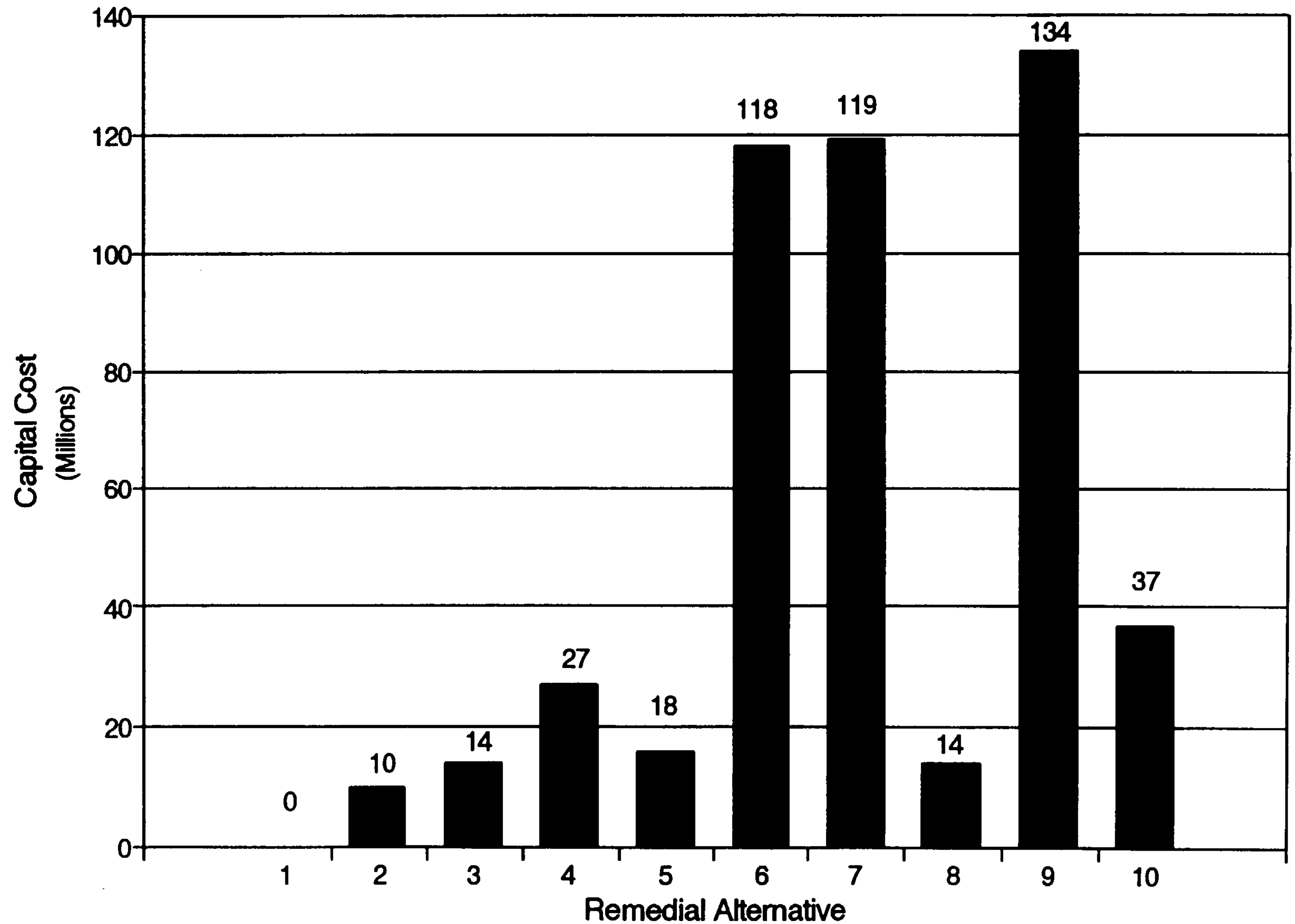
Remedial Alternative 2, consisting of limited containment options, and Remedial Alternative 8, were estimated to be the least expensive in capital expenditure, while Remedial Alternative 6 was the most expensive. A comparison of the capital costs for each remedial alternative is presented in Figure 7-1.

Table 7-7. Cost Comparison of Sitewide Alternatives

REMEDIAL ALTERNATIVE	CAPITAL COST	ANNUAL O&M COST (Years 1-10)*	ANNUAL O&M COST (Years 11-30)	PRESENT WORTH
1	$0	$0	$0	$0
2	$10,000,000	$180,000	$1,300,000	$15,400,000
3	$14,000,000	$180,000	$1,300,000	$19,400,000
4	$27,000,000	$180,000	$1,300,000	$32,400,000
5	$16,000,000	$180,000	$1,300,000	$21,400,000
6	$118,000,000	$180,000	$1,300,000	$123,000,000
7	$119,000,000	$180,000	$1,300,000	$124,000,000
8	$14,000,000	$180,000	$1,300,000	$19,400,000
9	$134,000,000	$180,000	$3,000,000	$145,000,000
10	$37,000,000	$180,000	$3,000,000	$48,000,000

* O&M for ground-water treatment included in capital cost of alternative.

Figure 7-1
Capital Cost Comparison



7.7.2 O&M Costs

The O&M cost analysis consisted of estimating the yearly cost for the operation and upkeep of the various remedial measures throughout the life of the project. For this FS, the life of each remedial measure has been assumed to be 30 years from the time of implementation. O&M cost figures for each remedial measure are summarized to provide an overall O&M cost for each remedial alternative. The final O&M figures also include cost of administration and a contingency.

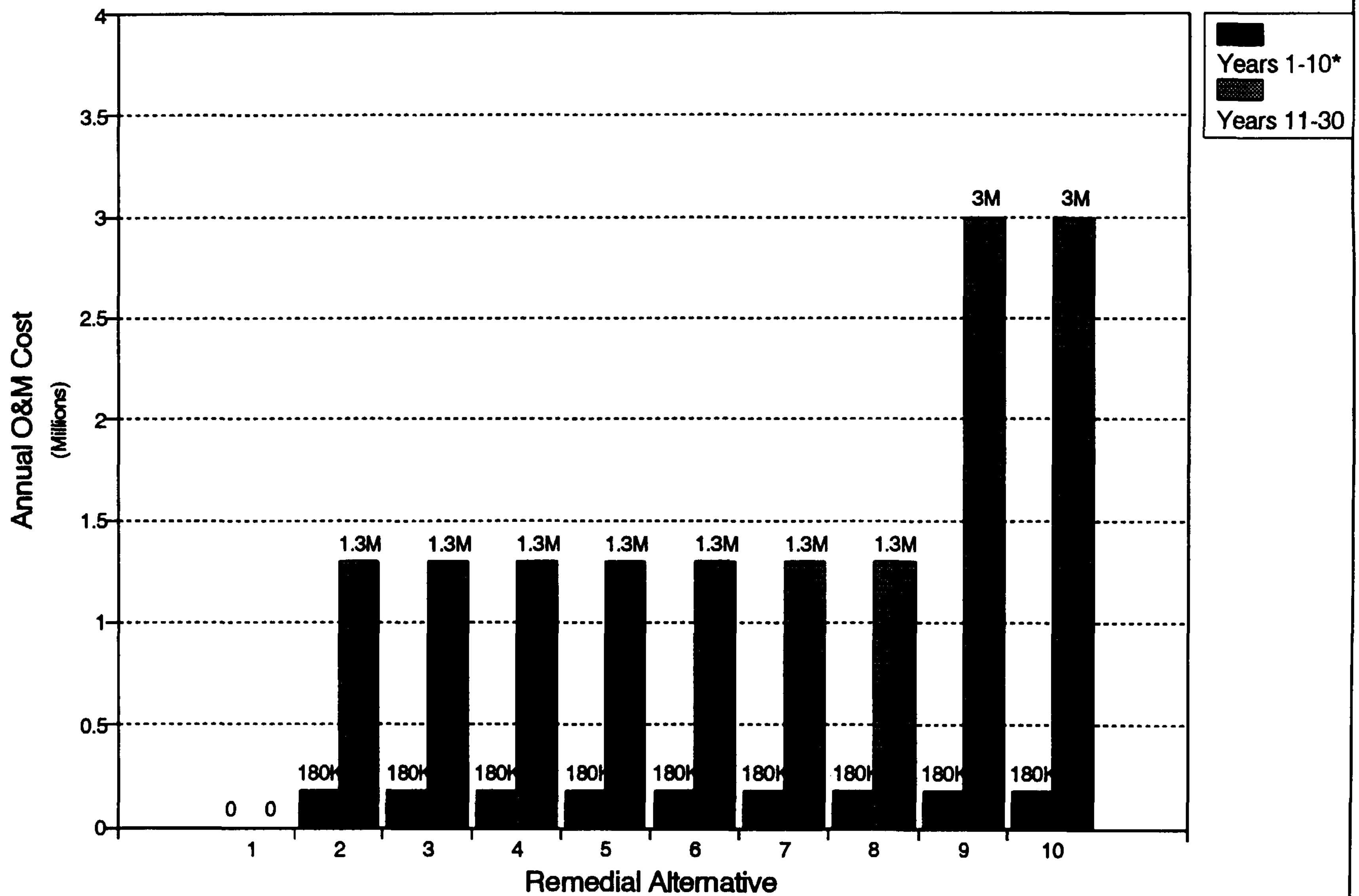
The annual O&M cost for Remedial Alternatives 2, 3, 4, 5, 8, and 10 are the lowest in terms of annual expenditure at $1.3 million each. Remedial Alternative 9 is the most expensive with an annual expenditure of $3 million for years 0 through 30. A comparison of the annual O&M costs for each remedial alternative appears in Figure 7-2.

7.7.3 Present Worth

In order to best compare the varying costs of different remedial alternatives, a present worth analysis was performed. The analysis consisted of calculating the present worth of the O&M costs over the project life and adding the capital costs. A 10% interest factor was used in present worth calculations in accordance with the USEPA guidance.

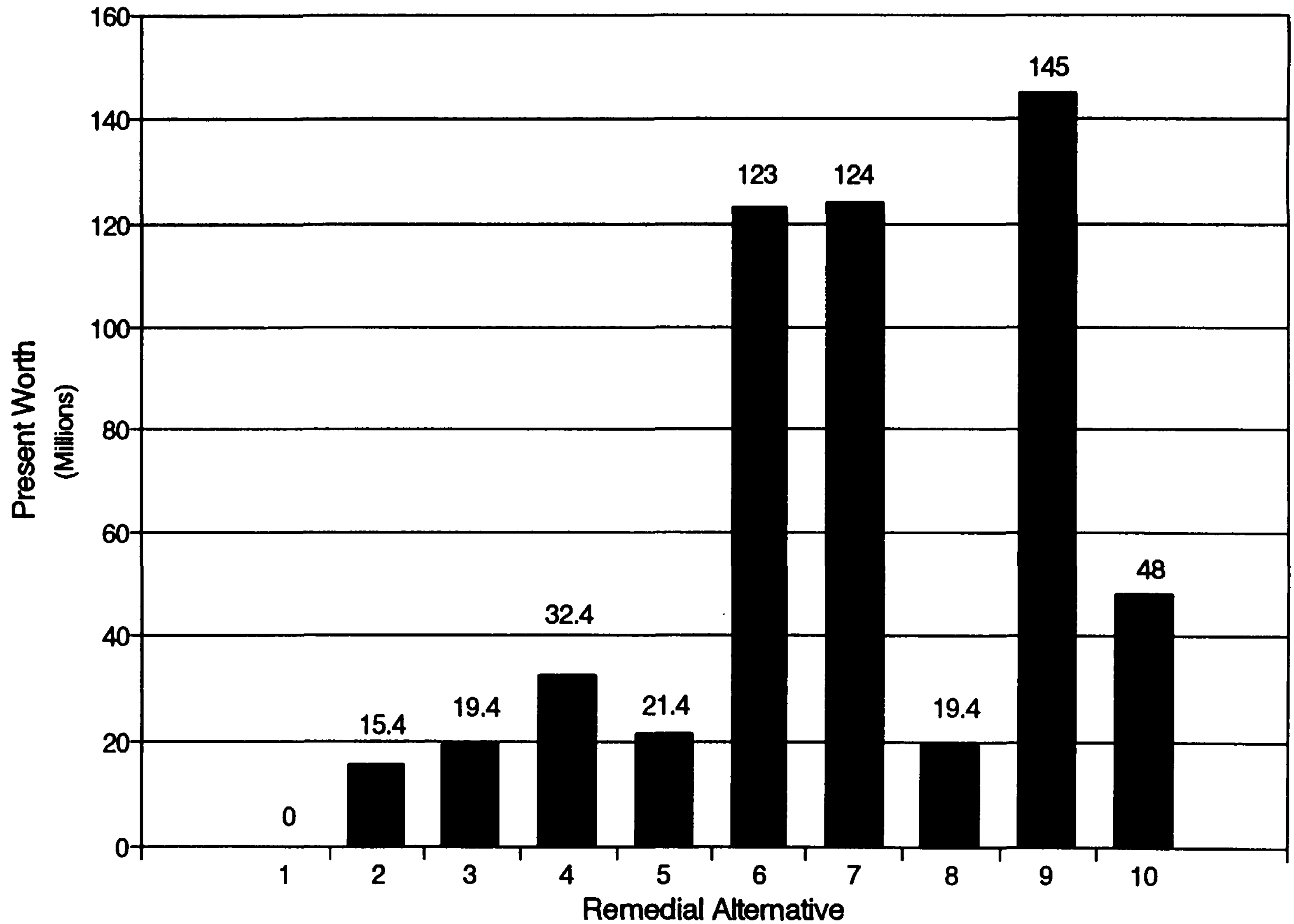
The present worth of each remedial alterative is presented in Figure 7-3. Remedial Alternative 2 and Remedial Alternative 8 have the lowest present worth, while Remedial Alternative 9 has the highest present worth.

Figure 7-2
Annual O&M Cost Comparison



* Ground-Water Treatment O&M Applied to Capital Cost

Figure 7-3
Present Worth Comparison



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APPENDIX A

DETERMINATION OF BAT FOR TREATING GROUND WATER AT THE ORMET SITE

1.0 BACKGROUND

The Ormet Corporation operates a primary aluminum reduction facility on the west bank of the Ohio River near Hannibal, Ohio. In support of its manufacturing operations, the facility operates a Ranney well which extracts up to 1,700 gallons per minute (gpm) or 2.4 million gallons per day (gpd) of ground water from the alluvial aquifer. During the Remedial Investigation, the presence of contaminants including total cyanide, were detected in the alluvial aquifer. In order to maintain the quality of the water extracted by the Ranney well, Ormet installed and operates one of two interceptor wells upgradient of the Ranney well and down gradient of the source areas. The ground water extracted by interceptor wells number 1 and 2 is approximately 340,000 gpd. Currently, the ground water extracted by the two interceptor wells is discharged to the Ohio River via the facility's Outfall 004. The discharge of the extracted ground water is subject to permit number OIE00005*BD issued to Ormet Corporation by the Ohio Environmental Protection Agency (OEPA) under the National Pollutant Discharge Elimination System (NPDES) and a Settlement Agreement which requires the construction of a treatment facility to treat the extracted ground water prior to discharge.

In connection with settlement discussions with OEPA, Ormet agreed to undertake an extensive and rigorous program of ground water characterization studies followed by bench and pilot plant studies to identify and determine the Best Available Technology (BAT) for treating the ground water extracted from interceptor wells 1 or 2. This appendix summarizes the extensive studies that have been undertaken by the Ormet Corporation as directed by the OEPA. The study, which was essentially a customized research and development program, cost over $350,000 and took over three years to complete. A complete chronology of events relating to these studies is presented in Table 1. All of the plans, reports, and other submittals summarized in this appendix were submitted to OEPA and formed the basis for the program agreed to by Ohio EPA and Ormet in the Settlement Agreement.

2.0 GROUND-WATER CHARACTERIZATION AND TREATMENT FEASIBILITY STUDY

The first major activity undertaken involved a ground-water characterization and treatment feasibility study for the interceptor well water. In November 1987, Ormet contracted with Baker/TSA, Inc. to perform the ground-water characterization and treatment feasibility study.

This study included two major objectives. The first objective was to characterize the chemical quality of the ground water extracted by the interceptor wells. Data collected during this study demonstrated that, with the exception of total cyanide, the facility's discharge meets the applicable NPDES effluent limitations. Specifically, the total cyanide concentrations in the interceptor well water were found to average 5 mg/L[1]. Another important finding was the fact that the cyanide is present predominantly in a non-toxic complexed form rather than as free cyanide.

The second objective of this work was to determine the feasibility of treatment. This work was also performed by Baker/TSA, Inc. and is described in a report entitled "Treatment Feasibility Study For Cyanide In The Ormet Groundwater Discharge," dated January 1988. A copy of the report is presented in Attachment B. The data generated during the ground-water characterization was utilized to review the potential applicability of technologies available for the treatment of wastewaters containing cyanide. Based upon this review, it was determined that chemical precipitation/coagulation utilizing lime and

[1]Routine NPDES monitoring of the interceptor well water shows that current total cyanide concentrations are approximately 5 mg/L. This is consistent with a declining trend in cyanide concentrations over time since initiation of this monitoring in 1982 (see Attachment A).

ferrous /ferric iron salts is the most appropriate technology for reducing the amount of total cyanide in Ormet's interceptor well water discharge.

Bench-scale treatability studies were conducted using the chemical precipitation/coagulation technology on the ground water extracted by the interceptor wells. Subsequent to the performance of the treatment feasibility study, a "General Process Plan For The Treatment Of Interceptor Well Water," dated December 1988 was developed. A copy of this plan is presented in Attachment C. This report summarized the iron complexation chemistry of cyanide and presented the findings of the bench-scale treatability studies. In addition, this report presented the conceptual parameters for a cyanide treatment system and discussed the need for conducting pilot-plant testing. This report was submitted to the OEPA on December 12, 1988.

3.0 PILOT-SCALE STUDIES

In light of the need to perform pilot plant scale testing of the chemical precipitation/coagulation technology, Baker/TSA, Inc. was retained to perform the pilot plant work. A description of the pilot plant plan is contained in "Pilot Plant Plan For Proposed Treatment Of Interceptor Well Water," dated January 26, 1989, and is presented in Attachment D. This plan was submitted to the OEPA on January 27, 1989. The objectives of the pilot studies were to:

- o determine the design criteria and operating conditions of the individual process components and the overall system;

- o evaluate the of the effluent in terms of its chemical composition and toxicity as a function of varying the operating conditions; and

- o establish a technical basis for determining the economic feasibility of treatment.

The first phase of the pilot plant treatment study involved a series of 15 test runs in which a number of operating parameters including the Fe:Cn dosage ratio, the reaction pH, the lime dosage, and the chemical reaction time (CRT) were independently varied. Three of the runs were performed as duplicates of test conditions for an assessment of the performance variability. The second phase of the pilot plant testing was a longer-term evaluation of the performance of the technology.

The Phase I pilot plant operations were initiated on March 13, 1989 and continued until April 27, 1989. Toxicity testing was performed during this time as described in Section 4.0. Following completion of the Phase I work, Ormet presented proposed operating parameters for the Phase II evaluation. The OEPA approved these parameters on July 11, 1989 and the Phase II pilot testing was initiated on July 17, 1989. The pilot plant was operated until completion of the Phase II evaluation on September 19, 1989. The results of the Phase II pilot plant work is contained in a report entitled, "Pilot Plant Report On Proposed Treatment Of Interceptor Well Discharge," dated November 6, 1989 (see Attachment E). During the Phase II work, three rounds of samples were collected for toxicity testing as discussed in Section 4.0.

As a result of some variability in the data obtained during Phase II, it was concluded that further pilot work was needed to identify and refine operating conditions for this technology as applied to this specific water. This Phase III pilot plant evaluation was initiated on March 17, 1990. The pilot plant was operated continuously for 33 days at the optimum operating conditions determined during the Phase I and Phase II evaluations. The results of the Phase III work are described in a report entitled, "Pilot Plant Report On Proposed Treatment Of Interceptor Well Discharge Phase 3 Operation," dated June 18, 1990 (see Attachment F).

4.0 TOXICITY TESTING

Ormet Corporation also performed a number of toxicity studies contemporaneously with the pilot-scale testing described in the previous section. A preliminary assessment of the potential impact on aquatic life due to the future discharge of the treatment effluent was performed as part of the overall treatability study for the interceptor well water. Baker/TSA, Inc. and Geraghty & Miller, Inc. were retained for this portion of the program. The specific activities that were undertaken are set forth in a plan entitled, "Toxicity Testing Plan For Discharge From Outfall 004 After Proposed Treatment Of Interceptor Well Water," dated January 26, 1989 (see Attachment G). As described in the work plan, the acute toxicity testing was performed according to protocols of the USEPA[2] and the OEPA[3]. This work plan was submitted to the OEPA on January 27, 1989.

Toxicity tests relating to the Phase I pilot plant study were performed in accordance with this plan on February 28, 1989 and April 25, 1989. Additional toxicity testing relating to the Phase II pilot plant study was performed according to the work plan on July 24, 1989, August 17, 1989, and September 14, 1989. During the Phase III pilot plant study, Ormet and OEPA sampled for additional toxicity testing on May 7, 1990. The results of the toxicity testing were submitted to the OEPA concurrently with the Phase III pilot plant report on June 18, 1990. The results of the toxicity testing are contained in a series of reports prepared by Geraghty & Miller, Inc. These reports are contained in Attachment H.

---

[2]U.S. Environmental Protection Agency, 1985. Methods For Measuring The Acute Toxicity Of Effluents To Freshwater And Marine Organisms."

[3]OEPA, 1987. "Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices.

Two of the findings resulting from the toxicity testing were significant. First, samples of the untreated discharge were not found to be acutely toxic to specimens of Ceriodaphnia dubia (water flea) and Pimephales promelas (fathead minnow). The second significant finding of the toxicity testing was that the treated effluent was also not acutely toxic to the test species. In both cases, there was essentially complete survival of the test species and little or no sublethal effects noted. The endpoints that were used to reach these determinations were:

- o Median Lethal Concentration (LC_{50}) - the concentration of effluent in water to which test organisms are exposed that is estimated to be lethal to 50 percent of the test organisms as determined by lack of movement on gentle prodding.

- o Median Effective Concentration (EC_{50}) - the concentration of effluent in water to which test organisms are exposed that is estimated to be effective in eliciting some type of sublethal response in 50 percent of the test organisms.

5.0 NPDES SETTLEMENT

Following completion of the pilot plant studies and submittal of the pilot plant reports, Ormet Corporation and the OEPA entered into a Settlement Agreement which defines BAT for the site (see Attachment I). Among other things, the agreement requires Ormet to design, construct, and place into service a treatment facility applying BAT for the reduction of total cyanide in the ground-water discharge from interceptor wells number 1 or 2 via NPDES Outfall OIE00005603. The Settlement Agreement was filed with the Ohio Environmental Board of Review (EBR) on June 17, 1991.

Table 1. Ground-Water Treatment Chronology of Events

November 1987	Ormet contracted Baker/TSA to conduct treatment facility study of Ormet ground-water discharge.
January 1988	Baker/TSA report issued "Treatment Feasibility Study for Cyanide in the Ormet Groundwater Discharge."
August 15 & 29, 1988	Conducted bench tests at Baker/TSA.
December 12, 1988	Submitted "General Process Plan" and Toxicity Testing Plan" to OEPA.
February 28, 1989	Performed first set of toxicity tests.
March 13, 1989	Start-up Phase I Pilot Plant.
April 6, 1989	Submitted Toxicity Report.
April 25, 1989	Performed second set of toxicity tests.
April 27, 1989	Completed Phase I Pilot Plant.
June 6, 1989	Submitted Toxicity Report.
July 11, 1989	OEPA approval of Phase II parameters.
July 17, 1989	Start Phase II Pilot Plant.
July 24, 1989	Toxicity tests.
August 17, 1989	Toxicity tests.
September 14, 1989	Toxicity tests.
September 19, 1989	Conducted Phase II Pilot Plant.
October 2, 1989	Conducted Bench CN Tests.
November 6, 1989	Issued Pilot Plant and Toxicity Reports.

Table 1. Ground-Water Treatment Chronology of Events (Continued)

March 17, 1990	Start Phase III Pilot Plant.
May 7, 1990	Ormet and OEPA sampled for Toxicity Tests.
June 18, 1990	Issued Phase III Report and Toxicity Report.
August 17, 1990	OEPA accepted the Pilot Plant work as BAT.
June 17, 1991	Final Settlement Agreement

APPENDIX B

SOIL GRAIN SIZE ANALYSES

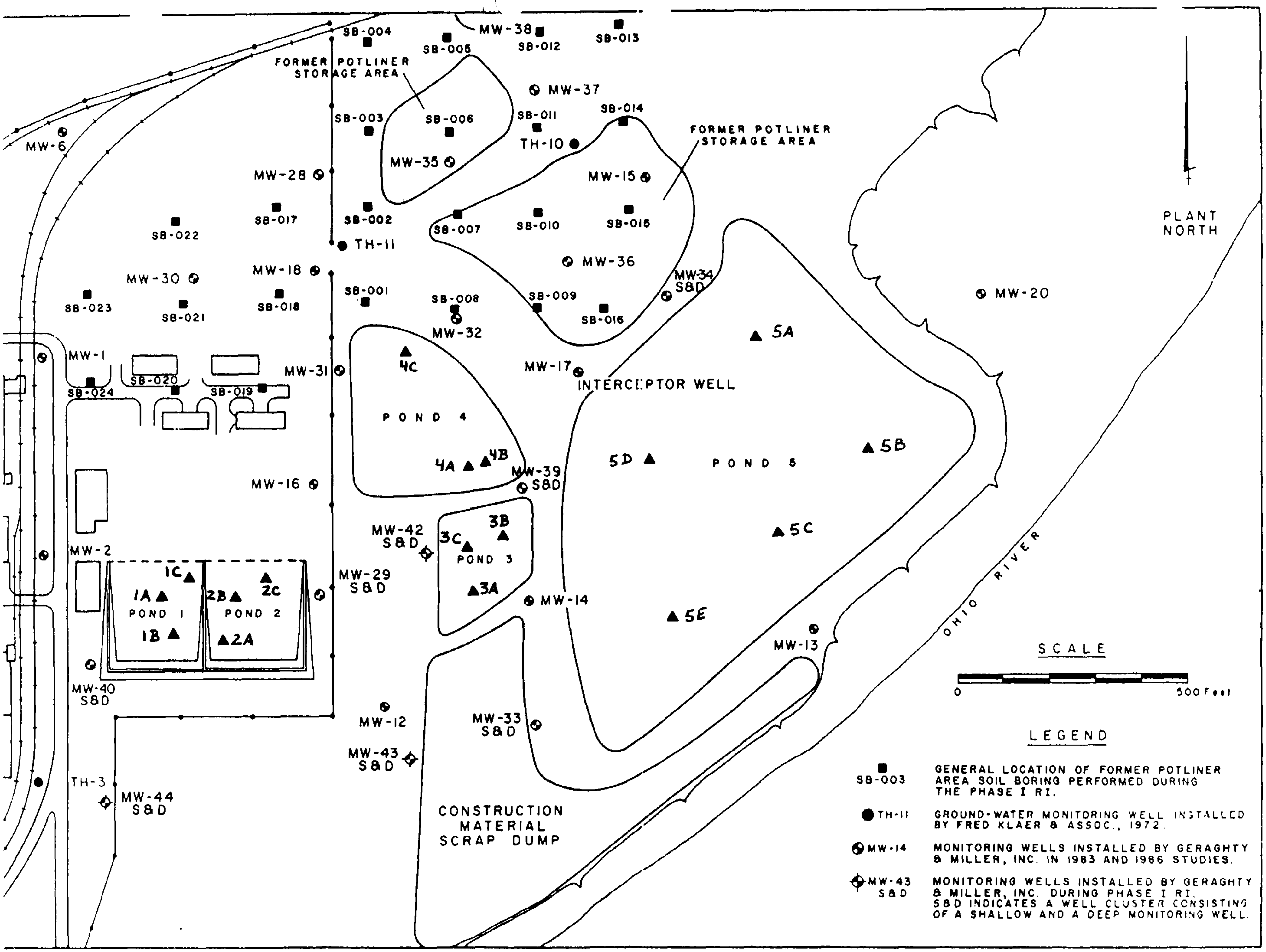

FIGURE 1. General Sieve Analysis Sampling Locations

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5350 Campbells Run Road
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P.O. Box 630832
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412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 1-A
NUS SAMPLE NO: P0151874
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.8	% Passed
	h. Sieve No. 10	99.1	% Passed
	i. Sieve No. 20	97.1	% Passed
	j. Sieve No. 40	90.8	% Passed
	k. Sieve No. 60	81.3	% Passed
	l. Sieve No. 140	55.9	% Passed
	m. Sieve No. 200	42.6	% Passed
	n. Particle Size .023	9.8	% Passed
	o. Particle Size .006	3.6	% Passed
	p. Particle Size .001	1.5	% Passed

COMMENTS:

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 1-B
NUS SAMPLE NO: P0151875
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.8	% Passed
	h. Sieve No. 10	99.7	% Passed
	i. Sieve No. 20	99.3	% Passed
	j. Sieve No. 40	97.3	% Passed
	k. Sieve No. 60	90.9	% Passed
	l. Sieve No. 140	65.2	% Passed
	m. Sieve No. 200	52.6	% Passed
	n. Particle Size .023	18.2	% Passed
	o. Particle Size .007	9.9	% Passed
	p. Particle Size .001	3.6	% Passed

COMMENTS:

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 1-C
NUS SAMPLE NO: P0151876
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	g. Sieve No. 4	100.0	% Passed
	h. Sieve No. 10	99.4	% Passed
	i. Sieve No. 20	96.6	% Passed
	j. Sieve No. 40	84.5	% Passed
	k. Sieve No. 60	59.0	% Passed
	l. Sieve No. 140	20.1	% Passed
	m. Sieve No. 200	10.9	% Passed
	n. Particle Size .023	0.0	% Passed
	o. Particle Size .007	0.0	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 2-A
NUS SAMPLE NO: P0151877
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.1	% Passed
	h. Sieve No. 10	96.7	% Passed
	i. Sieve No. 20	93.0	% Passed
	j. Sieve No. 40	89.0	% Passed
	k. Sieve No. 60	86.1	% Passed
	l. Sieve No. 140	81.4	% Passed
	m. Sieve No. 200	77.7	% Passed
	n. Particle Size .022	33.9	% Passed
	o. Particle Size .007	11.6	% Passed
	p. Particle Size .001	3.5	% Passed

COMMENTS:

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VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 2-B
NUS SAMPLE NO: P0151878
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	87.3	% Passed
	h. Sieve No. 10	60.7	% Passed
	i. Sieve No. 20	52.6	% Passed
	j. Sieve No. 40	47.2	% Passed
	k. Sieve No. 60	39.9	% Passed
	l. Sieve No. 140	23.3	% Passed
	m. Sieve No. 200	17.6	% Passed
	n. Particle Size .024	2.2	% Passed
	o. Particle Size .007	0.9	% Passed
	p. Particle Size .001	0.0	% Passed

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 2-C
NUS SAMPLE NO: P0151879
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.8	% Passed
	h. Sieve No. 10	99.1	% Passed
	i. Sieve No. 20	97.5	% Passed
	j. Sieve No. 40	93.7	% Passed
	k. Sieve No. 60	82.5	% Passed
	l. Sieve No. 140	50.1	% Passed
	m. Sieve No. 200	34.5	% Passed
	n. Particle Size .024	5.6	% Passed
	o. Particle Size .007	3.6	% Passed
	p. Particle Size .001	1.5	% Passed

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 3-A
NUS SAMPLE NO: P0151880
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.5	% Passed
	h. Sieve No. 10	98.1	% Passed
	i. Sieve No. 20	95.2	% Passed
	j. Sieve No. 40	91.0	% Passed
	k. Sieve No. 60	86.7	% Passed
	l. Sieve No. 140	63.2	% Passed
	m. Sieve No. 200	45.7	% Passed
	n. Particle Size .023	7.7	% Passed
	o. Particle Size .007	1.5	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

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REPORT DATE: 01/02/91
ATTENTION: BOB FARGO
CC:

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

SAMPLE IDENTIFICATION: POND 3-B
NUS SAMPLE NO: P0151881
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.5	% Passed
	h. Sieve No. 10	97.0	% Passed
	i. Sieve No. 20	94.1	% Passed
	j. Sieve No. 40	91.8	% Passed
	k. Sieve No. 60	89.6	% Passed
	l. Sieve No. 140	78.4	% Passed
	m. Sieve No. 200	66.0	% Passed
	n. Particle Size .023	8.9	% Passed
	o. Particle Size .007	0.0	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

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REPORT DATE: 01/02/91
ATTENTION: BOB FARGO
CC:

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

SAMPLE IDENTIFICATION: POND 3-C
NUS SAMPLE NO: P0151882
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.1	% Passed
	h. Sieve No. 10	97.8	% Passed
	i. Sieve No. 20	97.2	% Passed
	j. Sieve No. 40	96.2	% Passed
	k. Sieve No. 60	94.5	% Passed
	l. Sieve No. 140	77.8	% Passed
	m. Sieve No. 200	66.3	% Passed
	n. Particle Size .023	13.5	% Passed
	o. Particle Size .007	5.5	% Passed
	p. Particle Size .001	1.4	% Passed

COMMENTS:

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 4-A
NUS SAMPLE NO: P0151883
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	e. 1/2 inch	100.0	% Passed
	f. 3/8 inch	99.0	% Passed
	g. Sieve No. 4	97.6	% Passed
	h. Sieve No. 10	96.7	% Passed
	i. Sieve No. 20	95.2	% Passed
	j. Sieve No. 40	93.0	% Passed
	k. Sieve No. 60	89.4	% Passed
	l. Sieve No. 140	84.3	% Passed
	m. Sieve No. 200	80.5	% Passed
	n. Particle Size .019	63.1	% Passed
	o. Particle Size .006	39.3	% Passed
	p. Particle Size .001	3.4	% Passed

COMMENTS:

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 4-B
NUS SAMPLE NO: P0151864
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.6	% Passed
	h. Sieve No. 10	99.5	% Passed
	i. Sieve No. 20	98.7	% Passed
	j. Sieve No. 40	97.5	% Passed
	k. Sieve No. 60	96.7	% Passed
	l. Sieve No. 140	92.7	% Passed
	m. Sieve No. 200	88.6	% Passed
	n. Particle Size .019	65.0	% Passed
	o. Particle Size .006	38.3	% Passed
	p. Particle Size .001	3.5	% Passed

COMMENTS:

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LABORATORY ANALYSIS REPORT

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 4-C
NUS SAMPLE NO: P0151885
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.9	% Passed
	h. Sieve No. 10	99.7	% Passed
	i. Sieve No. 20	92.5	% Passed
	j. Sieve No. 40	88.5	% Passed
	k. Sieve No. 60	86.7	% Passed
	l. Sieve No. 140	82.2	% Passed
	m. Sieve No. 200	79.2	% Passed
	n. Particle Size .020	53.8	% Passed
	o. Particle Size .007	18.2	% Passed
	p. Particle Size .001	3.6	% Passed

COMMENTS:

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LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 5-A
NUS SAMPLE NO: P0151886
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	h. Sieve No. 10	100.0	% Passed
	i. Sieve No. 20	59.0	% Passed
	j. Sieve No. 40	44.4	% Passed
	k. Sieve No. 60	38.0	% Passed
	l. Sieve No. 140	31.6	% Passed
	m. Sieve No. 200	29.8	% Passed
	n. Particle Size .021	13.3	% Passed
	o. Particle Size .007	4.5	% Passed
	p. Particle Size .001	1.1	% Passed

COMMENTS:

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NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 5-B
NUS SAMPLE NO: P0151887
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	g. Sieve No. 4	100.0	% Passed
	h. Sieve No. 10	99.7	% Passed
	i. Sieve No. 20	98.9	% Passed
	j. Sieve No. 40	96.9	% Passed
	k. Sieve No. 60	93.7	% Passed
	l. Sieve No. 140	77.0	% Passed
	m. Sieve No. 200	63.8	% Passed
	n. Particle Size .023	17.1	% Passed
	o. Particle Size .007	4.6	% Passed
	p. Particle Size .001	1.5	% Passed

COMMENTS:

CLIENT ORIGINAL

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 5-C
NUS SAMPLE NO: P0151888
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	g. Sieve No. 4	100.0	% Passed
	h. Sieve No. 10	83.7	% Passed
	i. Sieve No. 20	53.7	% Passed
	j. Sieve No. 40	36.3	% Passed
	k. Sieve No. 60	27.4	% Passed
	l. Sieve No. 140	19.6	% Passed
	m. Sieve No. 200	18.2	% Passed
	n. Particle Size .023	17.9	% Passed
	o. Particle Size .007	12.6	% Passed
	p. Particle Size .001	3.0	% Passed

COMMENTS:

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 5-D
NUS SAMPLE NO: P0151889
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	f. 3/8 inch	100.0	% Passed
	g. Sieve No. 4	99.6	% Passed
	h. Sieve No. 10	97.3	% Passed
	i. Sieve No. 20	92.6	% Passed
	j. Sieve No. 40	85.2	% Passed
	k. Sieve No. 60	74.3	% Passed
	l. Sieve No. 140	44.8	% Passed
	m. Sieve No. 200	29.8	% Passed
	n. Particle Size .024	2.4	% Passed
	o. Particle Size .007	0.4	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARCO
CC:

SAMPLE IDENTIFICATION: POND 5-E
NUS SAMPLE NO: P0151890
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	g. Sieve No. 4	100.0	% Passed
	h. Sieve No. 10	96.9	% Passed
	i. Sieve No. 20	77.5	% Passed
	j. Sieve No. 40	57.6	% Passed
	k. Sieve No. 60	47.9	% Passed
	l. Sieve No. 140	39.1	% Passed
	m. Sieve No. 200	36.4	% Passed
	n. Particle Size .022	28.9	% Passed
	o. Particle Size .007	20.7	% Passed
	p. Particle Size .001	7.6	% Passed

COMMENTS:

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205
412-747-2500

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-08

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-
REPORT DATE: 01/02/91
ATTENTION: BOB FARGO
CC:

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

SAMPLE IDENTIFICATION: SB-006
NUS SAMPLE NO: P0151891
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	d. 3/4 inch	100.0	% Passed
	e. 1/2 inch	92.2	% Passed
	f. 3/8 inch	81.6	% Passed
	g. Sieve No. 4	51.5	% Passed
	h. Sieve No. 10	23.2	% Passed
	i. Sieve No. 20	14.9	% Passed
	j. Sieve No. 40	6.4	% Passed
	k. Sieve No. 60	1.7	% Passed
	l. Sieve No. 140	0.9	% Passed
	m. Sieve No. 200	0.9	% Passed
	n. Particle Size .023	0.0	% Passed
	o. Particle Size .007	0.0	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-C
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: SB-008
NUS SAMPLE NO: P0151892
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	d. 3/4 inch	100.0	% Passed
	e. 1/2 inch	98.1	% Passed
	f. 3/8 inch	91.7	% Passed
	g. Sieve No. 4	47.3	% Passed
	h. Sieve No. 10	11.5	% Passed
	i. Sieve No. 20	3.0	% Passed
	j. Sieve No. 40	1.1	% Passed
	k. Sieve No. 60	0.6	% Passed
	l. Sieve No. 140	0.4	% Passed
	m. Sieve No. 200	0.3	% Passed
	n. Particle Size .023	0.0	% Passed
	o. Particle Size .007	0.0	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

CLIENT ORIGINAL

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/02/91

ATTENTION: BOB FARCO
CC:

SAMPLE IDENTIFICATION: SB-015
NUS SAMPLE NO: P0151893
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	d. 3/4 inch	100.0	% Passed
	e. 1/2 inch	93.5	% Passed
	f. 3/8 inch	85.4	% Passed
	g. Sieve No. 4	58.9	% Passed
	h. Sieve No. 10	33.7	% Passed
	i. Sieve No. 20	25.4	% Passed
	j. Sieve No. 40	18.1	% Passed
	k. Sieve No. 60	11.5	% Passed
	l. Sieve No. 140	5.7	% Passed
	m. Sieve No. 200	4.9	% Passed
	n. Particle Size .024	0.8	% Passed
	o. Particle Size .007	0.1	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/02/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: SB-016
NUS SAMPLE NO: P0151894
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	d. 3/4 inch	100.0	% Passed
	e. 1/2 inch	99.2	% Passed
	f. 3/8 inch	95.3	% Passed
	g. Sieve No. 4	80.3	% Passed
	h. Sieve No. 10	43.3	% Passed
	i. Sieve No. 20	24.8	% Passed
	j. Sieve No. 40	12.9	% Passed
	k. Sieve No. 60	7.4	% Passed
	l. Sieve No. 140	3.3	% Passed
	m. Sieve No. 200	2.4	% Passed
	n. Particle Size .024	0.2	% Passed
	o. Particle Size .007	0.0	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS:

GERAGHTY
& MILLER, INC.
Environmental Services

429 Washington Trust Building
Washington, Pennsylvania 15301
(412) 225-8615
FAX: (412) 222-5104

RECEIVED
JAN 14 1991
G & M RISK EVAL. GROUP

January 10, 1991

ORMET CORPORATION
P.O. Box 176
Hannibal, Ohio 43931

ATTENTION: Mr. John Reggi

Dear John:

In today's mail, I received revised sieve analysis reports from NUS for two of the pond solids samples (4A and 5E) and one of the surficial soil samples from the former spent potliner storage area (SB-006), along with grain-size plots for all of the samples. According to the cover letter from NUS, the sieve data for these three samples were revised, "due to a calculation error at the laboratory". I have enclosed copies of the revised data and the plots for your files and also forwarded copies to the individuals shown below.

If you have any questions regarding this transmittal, please contact me.

Respectfully

Robert L. Fargo

Robert L. Fargo
Associate/Senior Scientist

RLF/gb

cc: J. Claypool - G&M w/enc.
K. Davidson - OEPA Columbus w/enc.
J. Duchene - Life Systems w/enc.
S. Hulett - M&E w/enc.
F. Jones - G&M w/enc.
R. McBride - USEPA w/enc.
L. Simmons - EEM w/enc.
R. Stewart - OEPA SEDO w/enc.
R. Wiedman - ESC&M w/enc.

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0832
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
WORK ORDER NO: 55830

REPORT DATE: 01/03/91

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 4-A
NUS SAMPLE NO: P0151883
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	e. 1/2 inch	100.0	% Passed
	f. 3/8 inch	99.0	% Passed
	g. Sieve No. 4	97.6	% Passed
	h. Sieve No. 10	96.7	% Passed
	i. Sieve No. 20	95.2	% Passed
	j. Sieve No. 40	93.0	% Passed
	k. Sieve No. 60	90.3	% Passed
	l. Sieve No. 140	84.3	% Passed
	m. Sieve No. 200	80.5	% Passed
	n. Particle Size .019	63.1	% Passed
	o. Particle Size .006	39.3	% Passed
	p. Particle Size .001	3.4	% Passed

COMMENTS: REVISED REPORT.

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0832
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/03/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: SB-006
NUS SAMPLE NO: P0151891
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	d. 3/4 inch	100.0	% Passed
	e. 1/2 inch	92.8	% Passed
	f. 3/8 inch	81.6	% Passed
	g. Sieve No. 4	51.5	% Passed
	h. Sieve No. 10	23.2	% Passed
	i. Sieve No. 20	14.9	% Passed
	j. Sieve No. 40	6.4	% Passed
	k. Sieve No. 60	1.7	% Passed
	l. Sieve No. 140	0.9	% Passed
	m. Sieve No. 200	0.7	% Passed
	n. Particle Size .023	0.0	% Passed
	o. Particle Size .007	0.0	% Passed
	p. Particle Size .001	0.0	% Passed

COMMENTS: REVISED REPORT.

NUS CORPORATION

Laboratory Services Group
5350 Campbells Run Road
Pittsburgh, PA 15205

NUS CORPORATION
P.O. Box 630832
Baltimore, MD 21263-0832
412-747-2500

LABORATORY ANALYSIS REPORT

CLIENT NAME: GERAGHTY & MILLER, INC.
ADDRESS: 429 WASHINGTON TRUST BUILDING
WASHINGTON, PA 15301-

NUS CLIENT NO: 0617 0007
VENDOR NO: 05747503
REPORT DATE: 01/03/91
WORK ORDER NO: 55830

ATTENTION: BOB FARGO
CC:

SAMPLE IDENTIFICATION: POND 5-E
NUS SAMPLE NO: P0151890
DATE SAMPLED : 29-NOV-90
DATE RECEIVED: 05-DEC-90
APPROVED BY: R Volk

TEST	DETERMINATION	RESULT	UNIT
T45	Grain Size - Sieve & Hydrometer		
	g. Sieve No. 4	100.0	% Passed
	h. Sieve No. 10	96.9	% Passed
	i. Sieve No. 20	77.5	% Passed
	j. Sieve No. 40	57.6	% Passed
	k. Sieve No. 60	47.9	% Passed
	l. Sieve No. 140	39.1	% Passed
	m. Sieve No. 200	36.2	% Passed
	n. Particle Size .022	28.9	% Passed
	o. Particle Size .007	20.7	% Passed
	p. Particle Size .001	7.6	% Passed

COMMENTS: REVISED REPORT.

VUS CORPORATION

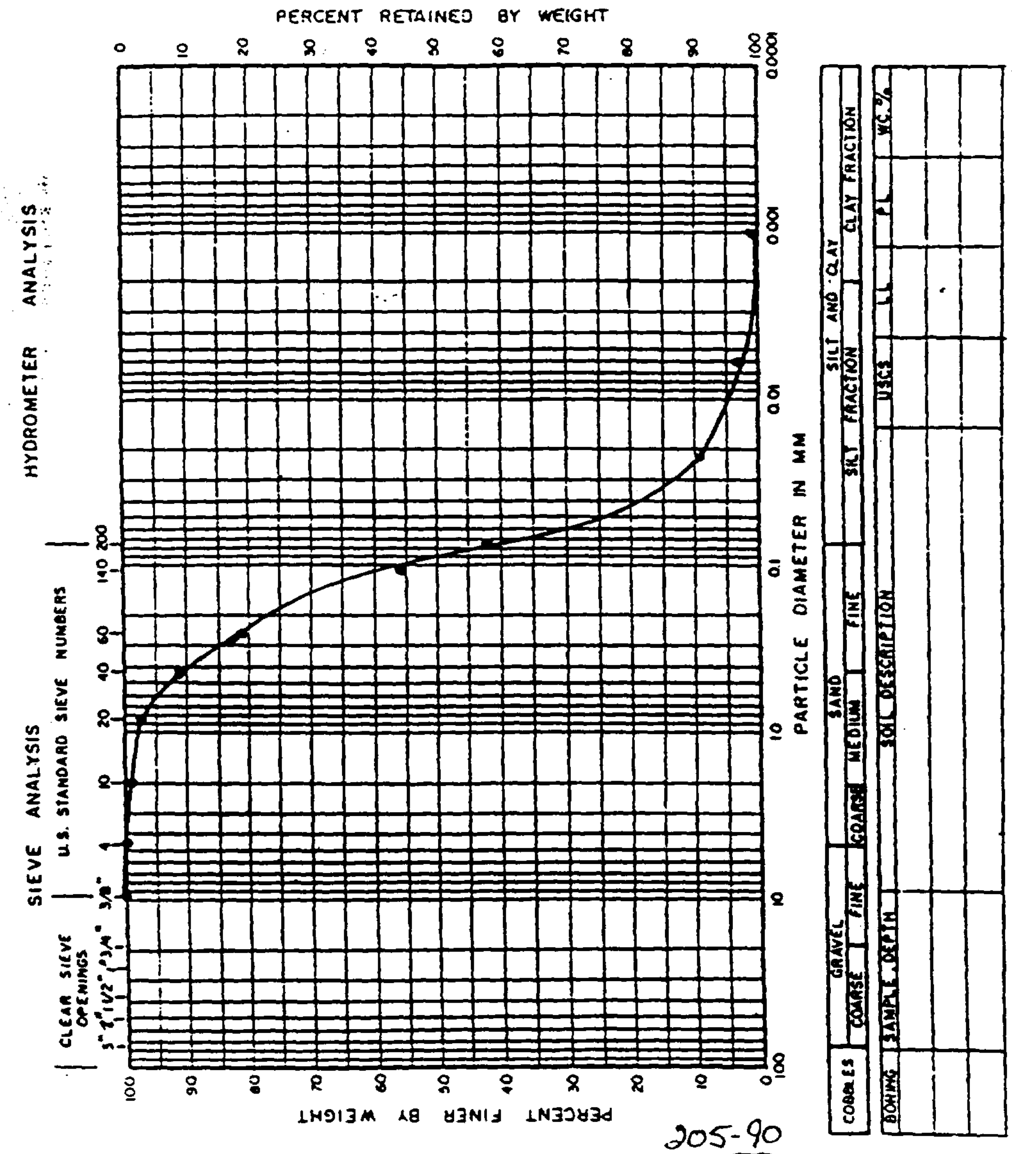
Laboratory No. P151874 Sheet ______ of ______

Name:	Geraghty Emiller	Project No.	Pond 1-A	Tested By	DN	Date	12/9/90
Test Pit No.		Sample No.		Calculated By	DN	Date	1/2/91
Depth		Sample Type		Checked By	JZL	Date	8JAN91

Description ______

Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

78

NUS CORPORATION

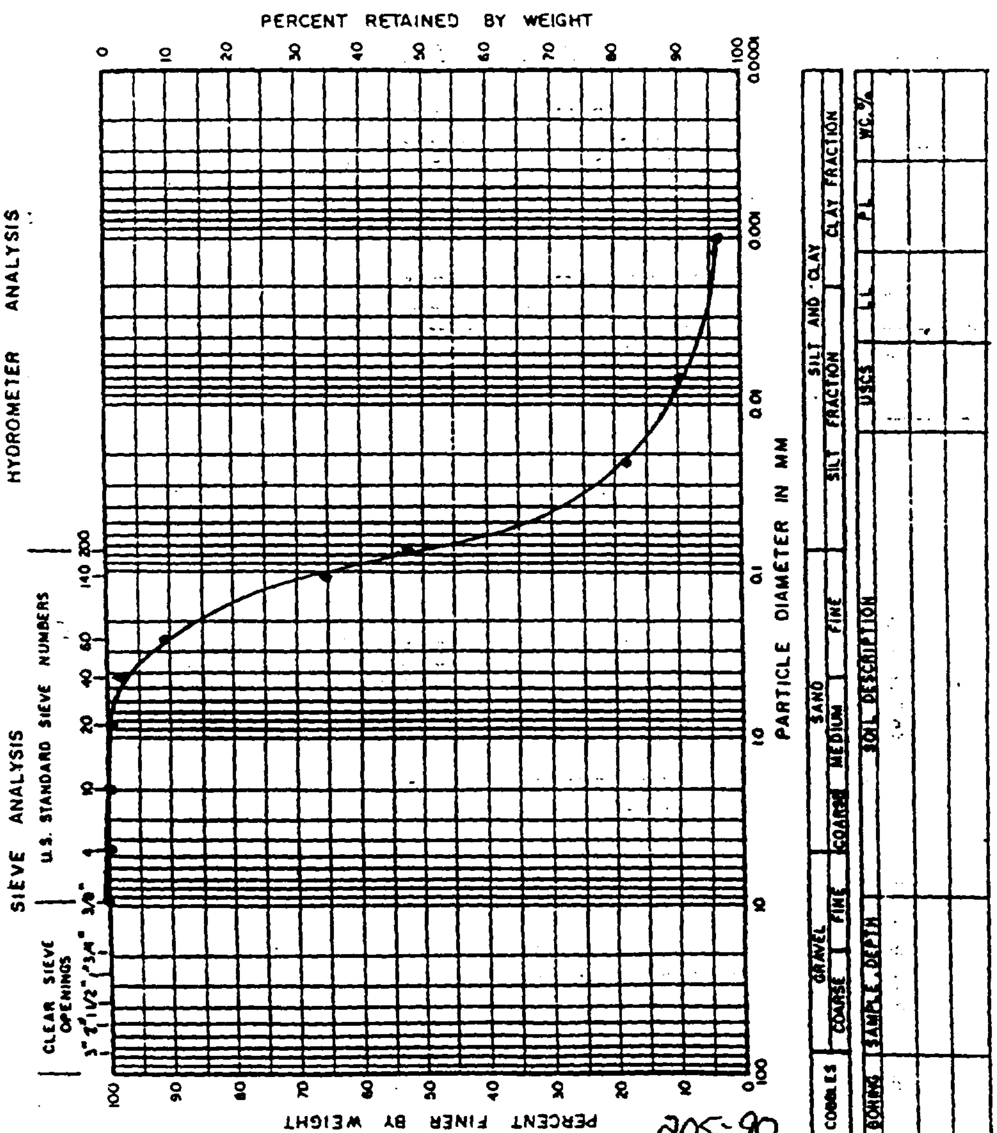
Laboratory No. P15B75 Sheet ______ of ______

Name:	Geraghty & Miller	Project No.	Pond 1-B	Tested By	DN	Date	12/9/90
Test Pit No.		Sample No.		Calculated By	DN	Date	1/2/91
Depth		Sample Type		Checked By	JCL	Date	8 JAN 91

Description ______________________________

Preparation Method ______________________________

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

79

Laboratory No. P151876 Sheet ______ of ______

NUS CORPORATION

ect Name: Geraghty & miller Project No. Pond 1-C Tested By DN/ Date 12/9/90

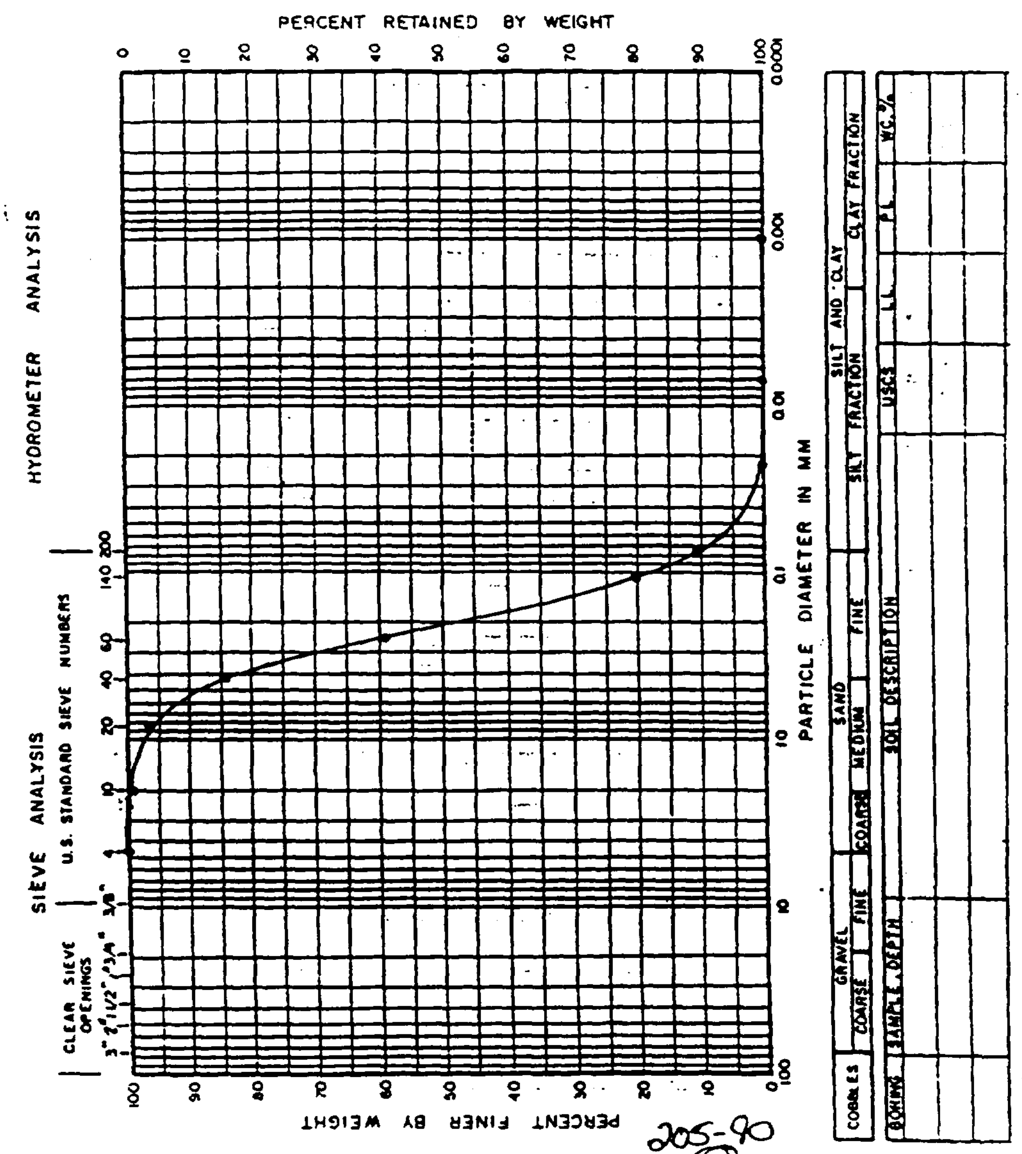
ing/Test Pit No. ______ Sample No. ______ Calculated By DN/ Date 1/2/91

nple Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

nple Description ______

nple Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

(80)

NUS CORPORATION

Laboratory No. P151877 Sheet ______ of ______

Project Name: Geraghty & miller Project No. Pond 2-A Tested By DN Date 12/7/90

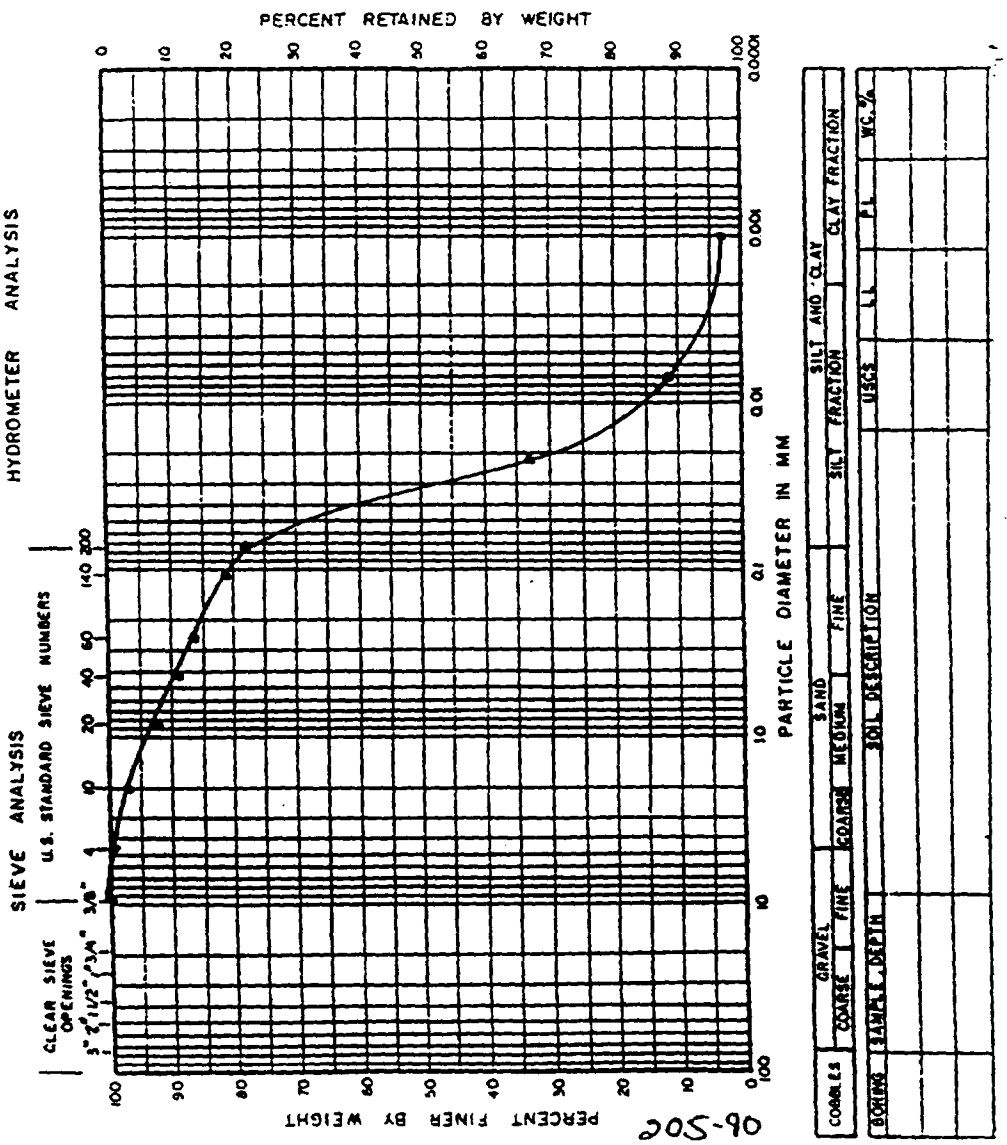
Boring/Test Pit No. ________ Sample No. ________ Calculated By DN Date 1/2/91

Sample Depth ________ Sample Type ________ Checked By JZL Date 8JAN91

Sample Description ________

Sample Preparation Method ________

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



06-502

81

Laboratory No. P151878 Sheet ______ of ______

NUS CORPORATION

Project Name: Geraghty & Miller Project No. Pond 2-B Tested By DN Date 12/9/90

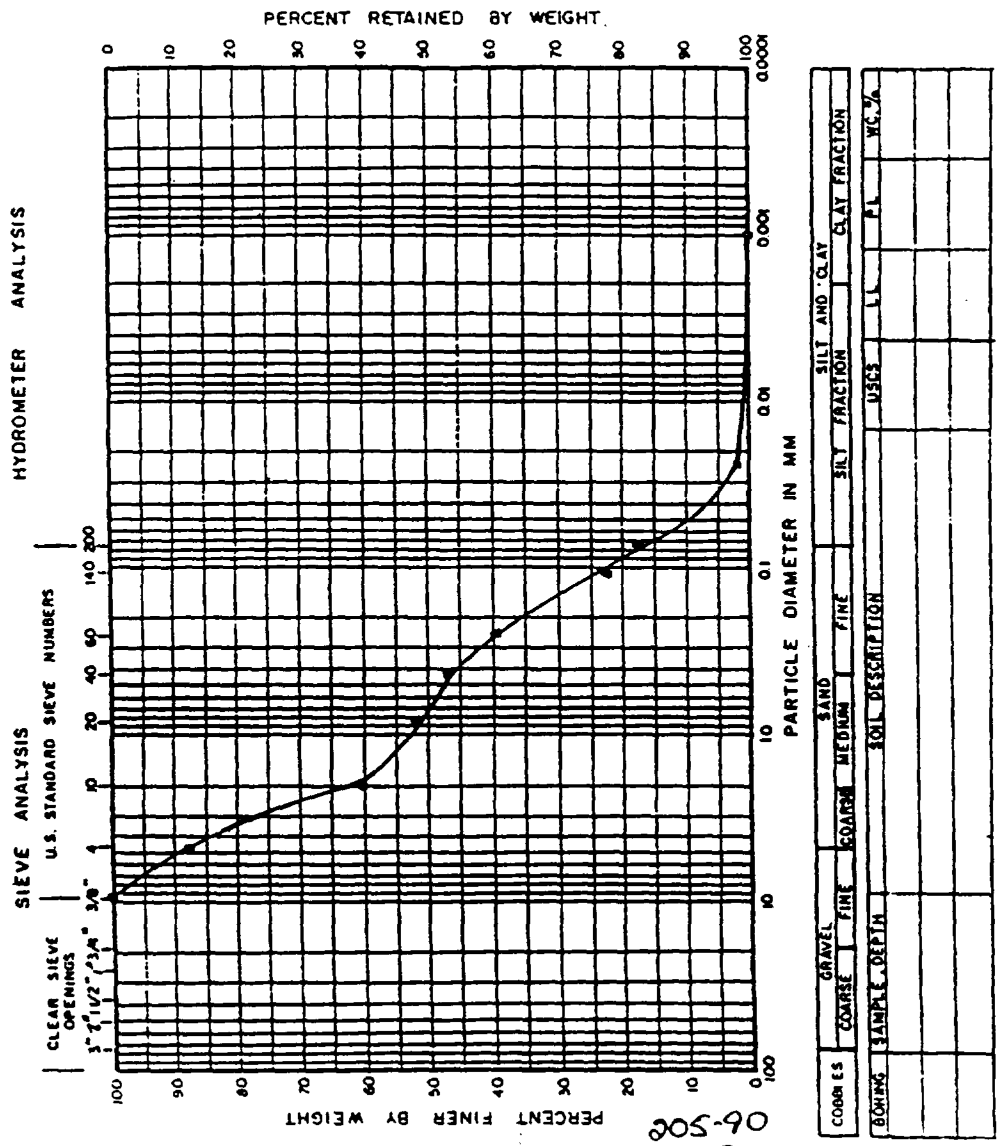
Boring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8 JAN 91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



06-50e

82

NUS CORPORATION

Laboratory No. P151879 Sheet ____ of ____

Project Name: Gaughty & milkk Project No. Pond 2-C Tested By DN Date 12/9/90

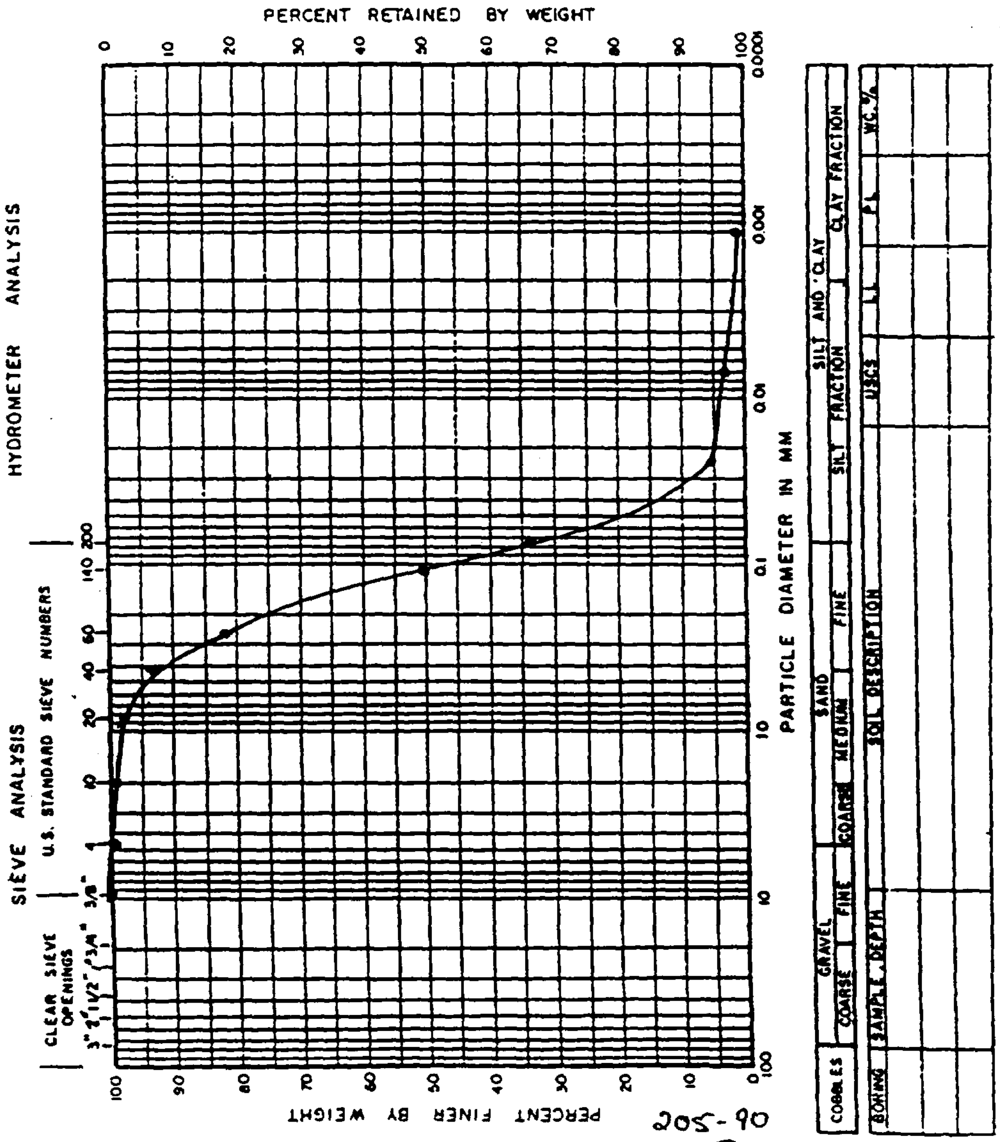
Boring/Test Pit No. ____ Sample No. ____ Calculated By DN Date 1/2/91

Sample Depth ____ Sample Type ____ Checked By JCL Date 8JAN91

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

83

NUS CORPORATION

Laboratory No. P151880 Sheet ____ of ____

Project Name: Geaghty & miller Project No. Pond 3-A Tested By DN Date 12/9/90

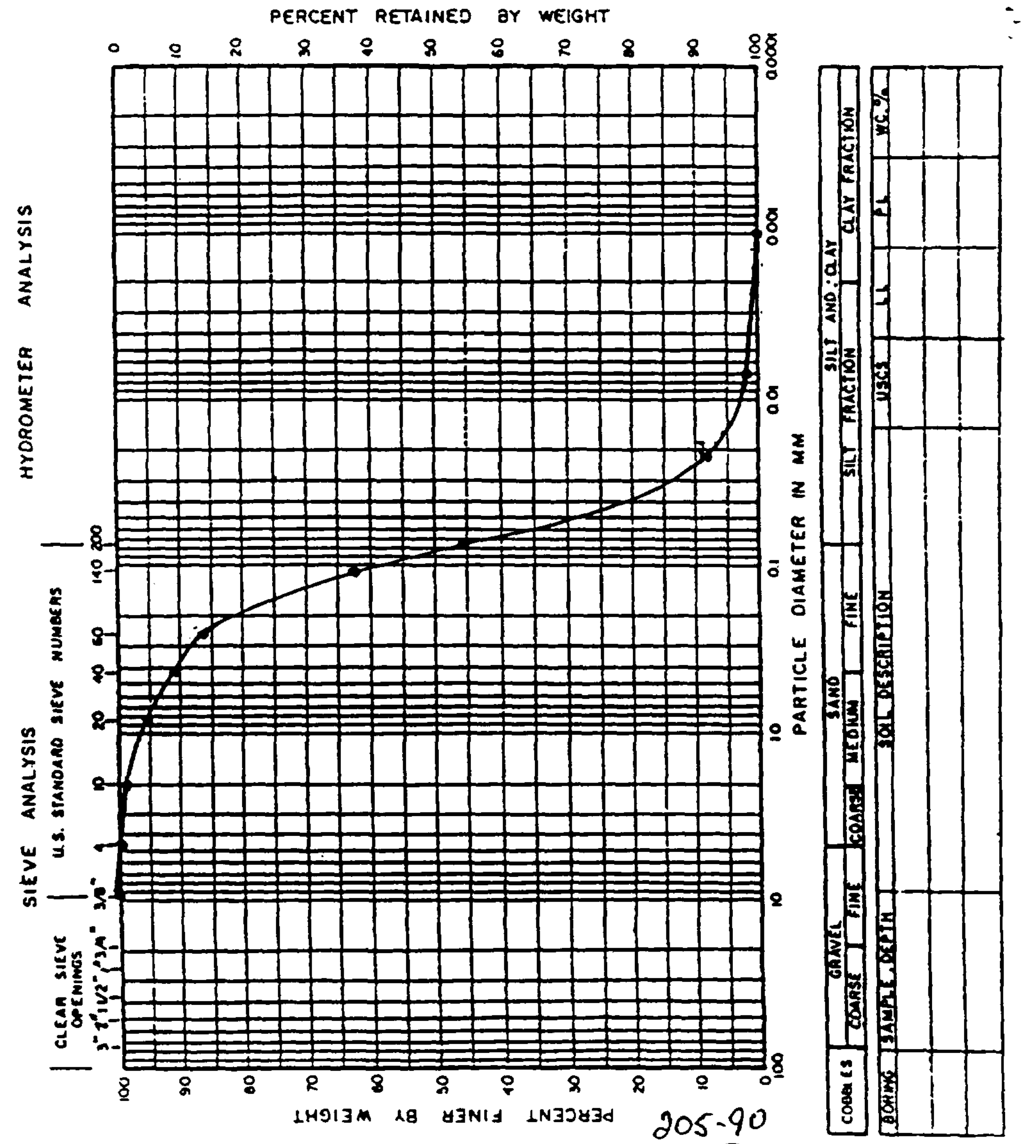
Boring/Test Pit No. ____ Sample No. ____ Calculated By DN Date 1/2/91

Sample Depth ____ Sample Type ____ Checked By JCL Date 8JAN91

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

89

Laboratory No. P151821 Sheet ______ of ______

NUS CORPORATION

roject Name: Geraghty & miller Project No. Pond 3-B Tested By DN Date 12/9/90

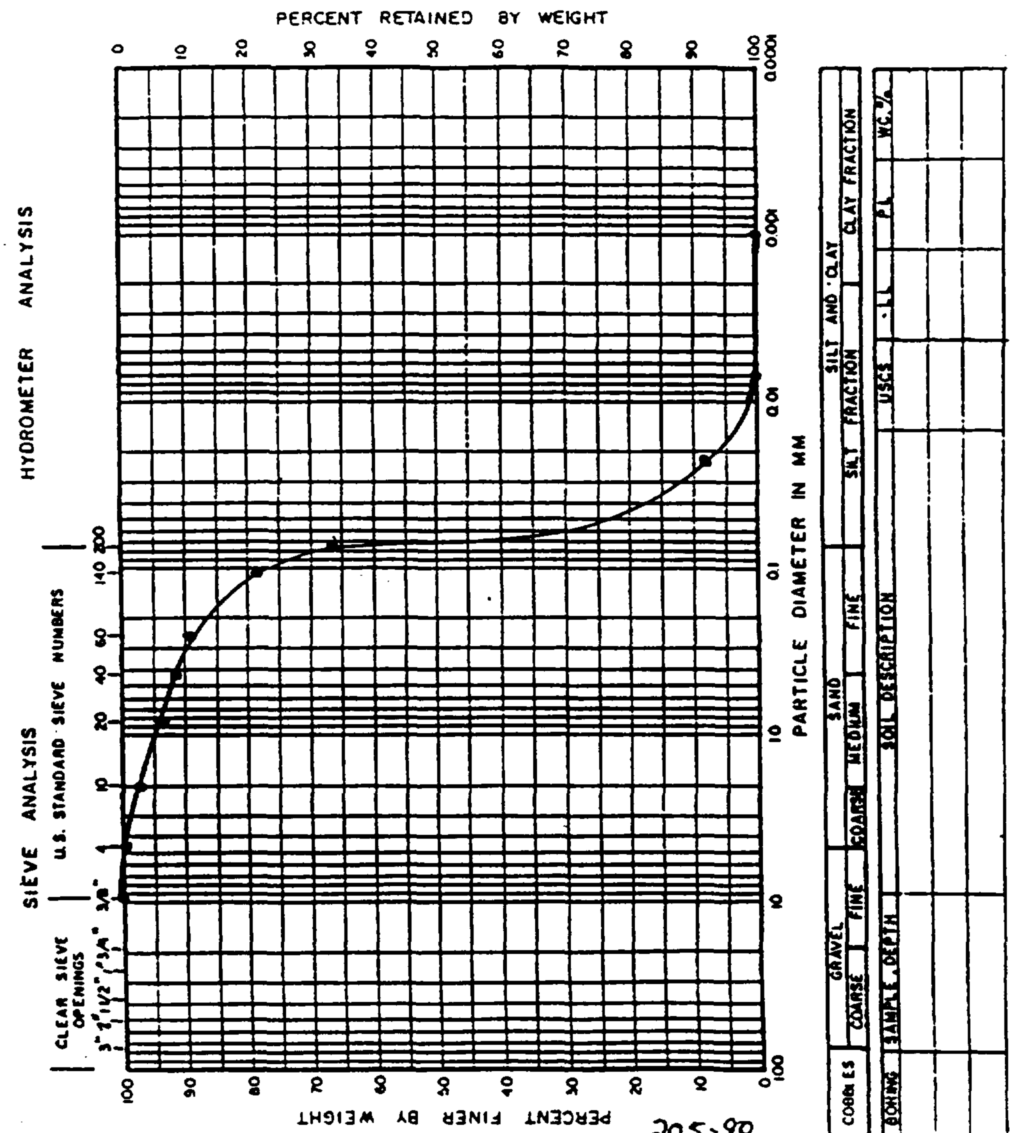
oring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

ample Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

ample Description ______

ample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

85

Laboratory No. P151882 Sheet ______ of ______

NUS CORPORATION

Project Name: Geraghty & Miller Project No. Pond 3-C Tested By DN Date 12/19/90

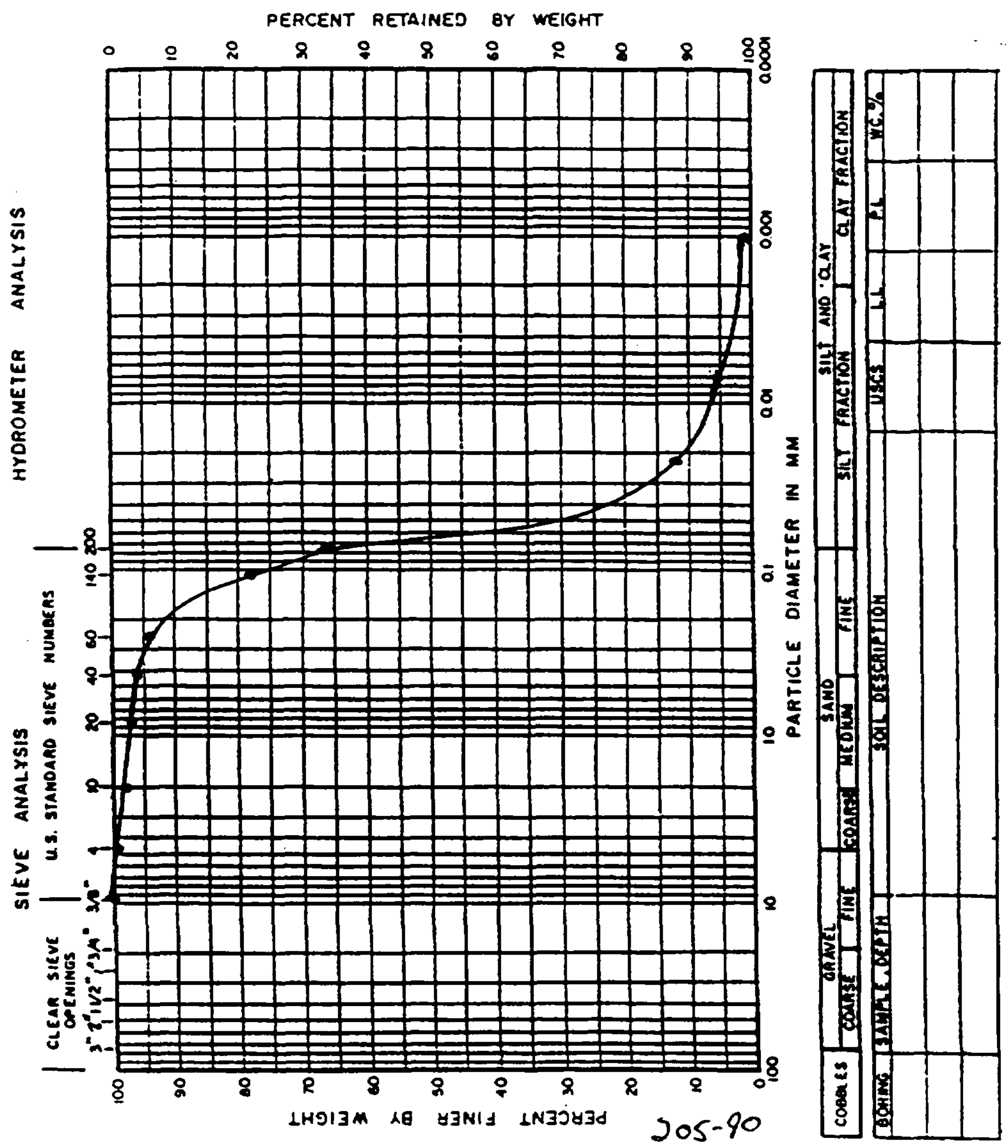
Boring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8 JAN 91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

86

NUS CORPORATION

Laboratory No. P151823 Sheet ____ of ____

Project Name: Geraghty & Miller Project No. Pond 4-A Tested By DN Date 12/9/90

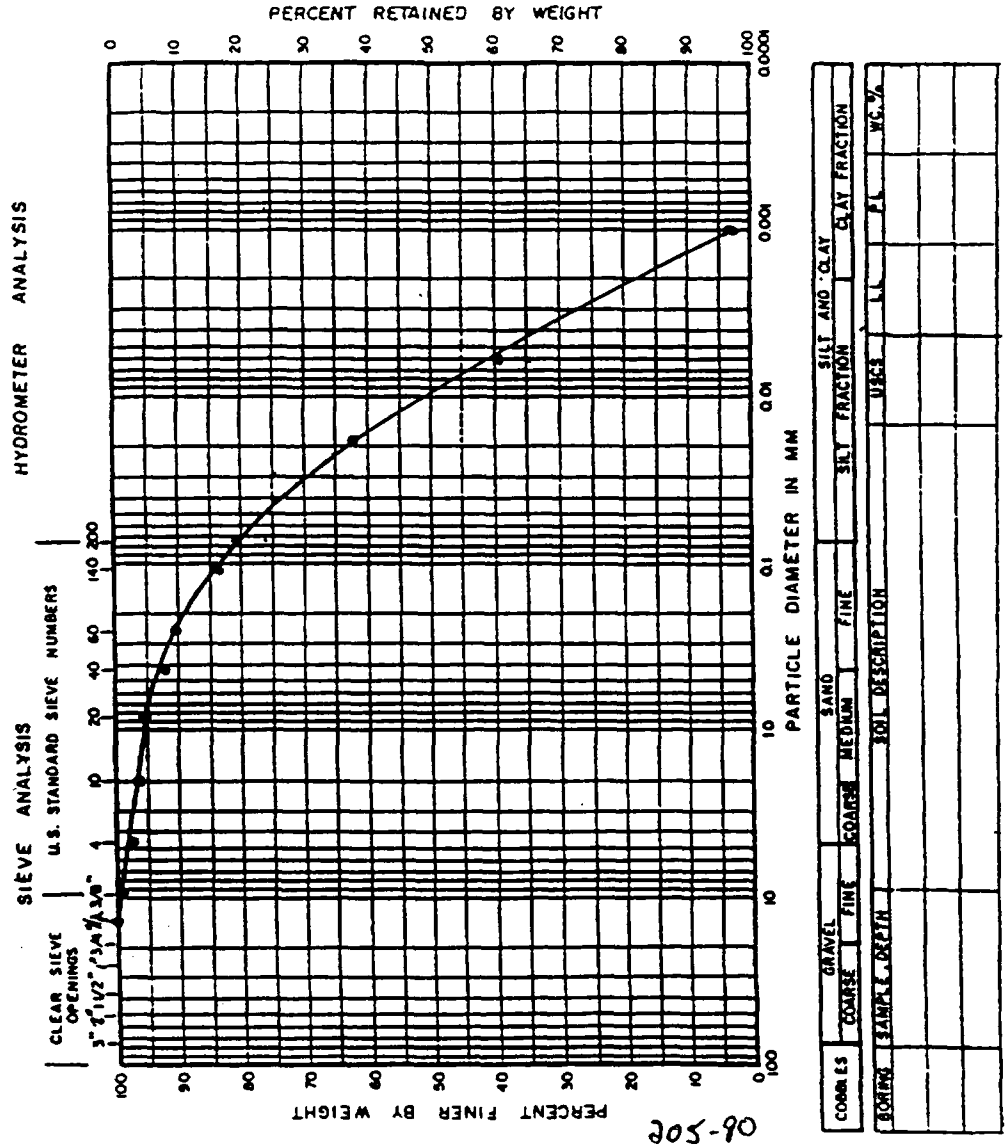
Boring/Test Pit No. ________ Sample No. ________ Calculated By DN Date 1/2/91

Sample Depth ________ Sample Type ________ Checked By JCL Date 8JAN91

Sample Description ________

Sample Preparation Method ________

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

87

Laboratory No. A51884 Sheet ______ of ______

NUS CORPORATION

Project Name: Geraghty & miller Project No. Pond 4-B Tested By ON Date 12/9/90

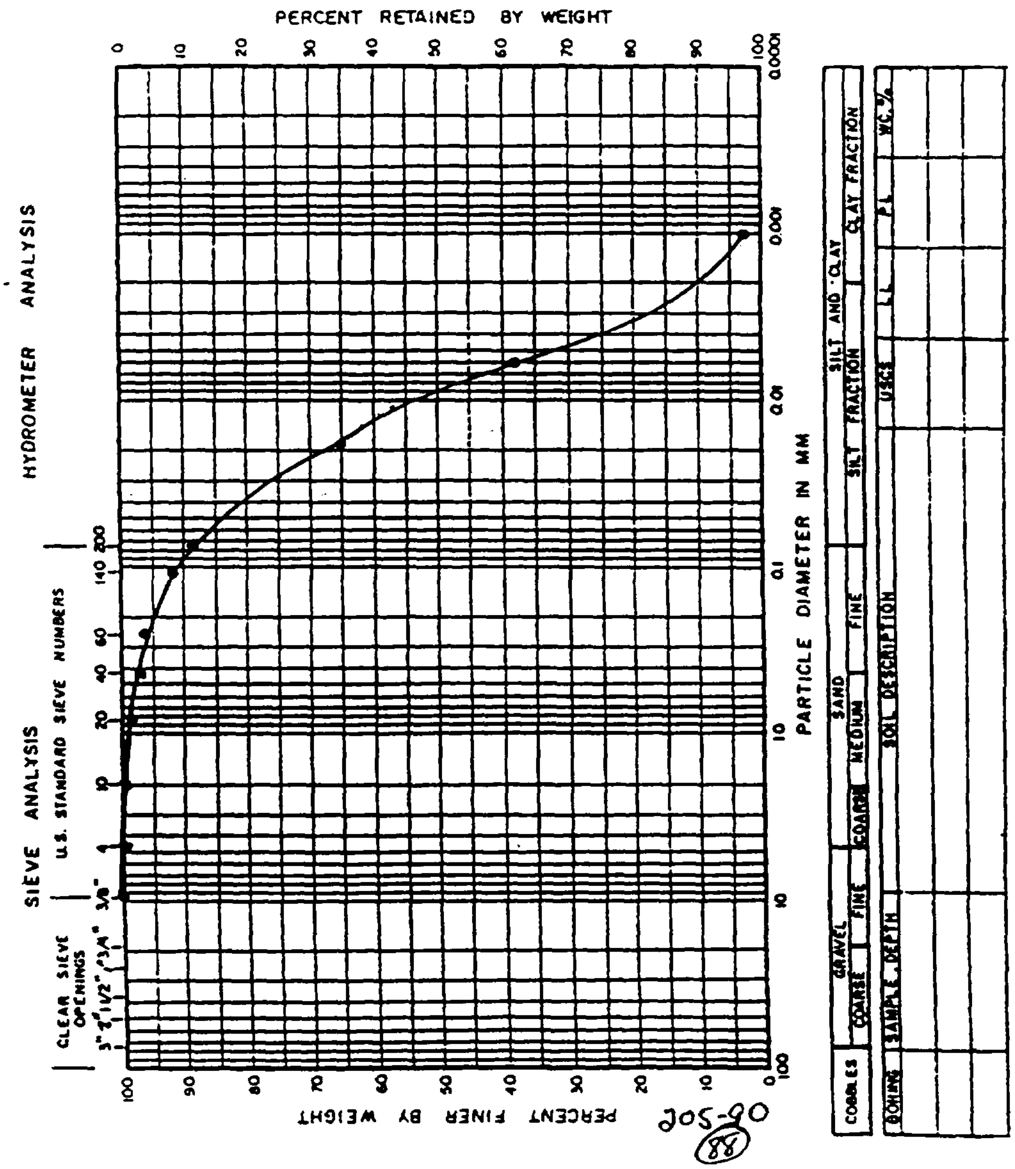
Boring/Test Pit No. ______ Sample No. ______ Calculated By ON Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



08-50C

88

NUS CORPORATION

Laboratory No. P151885 Sheet ______ of ______

Project Name: Geraghty & miller Project No. Pond 4-C Tested By DN Date 12/19/90

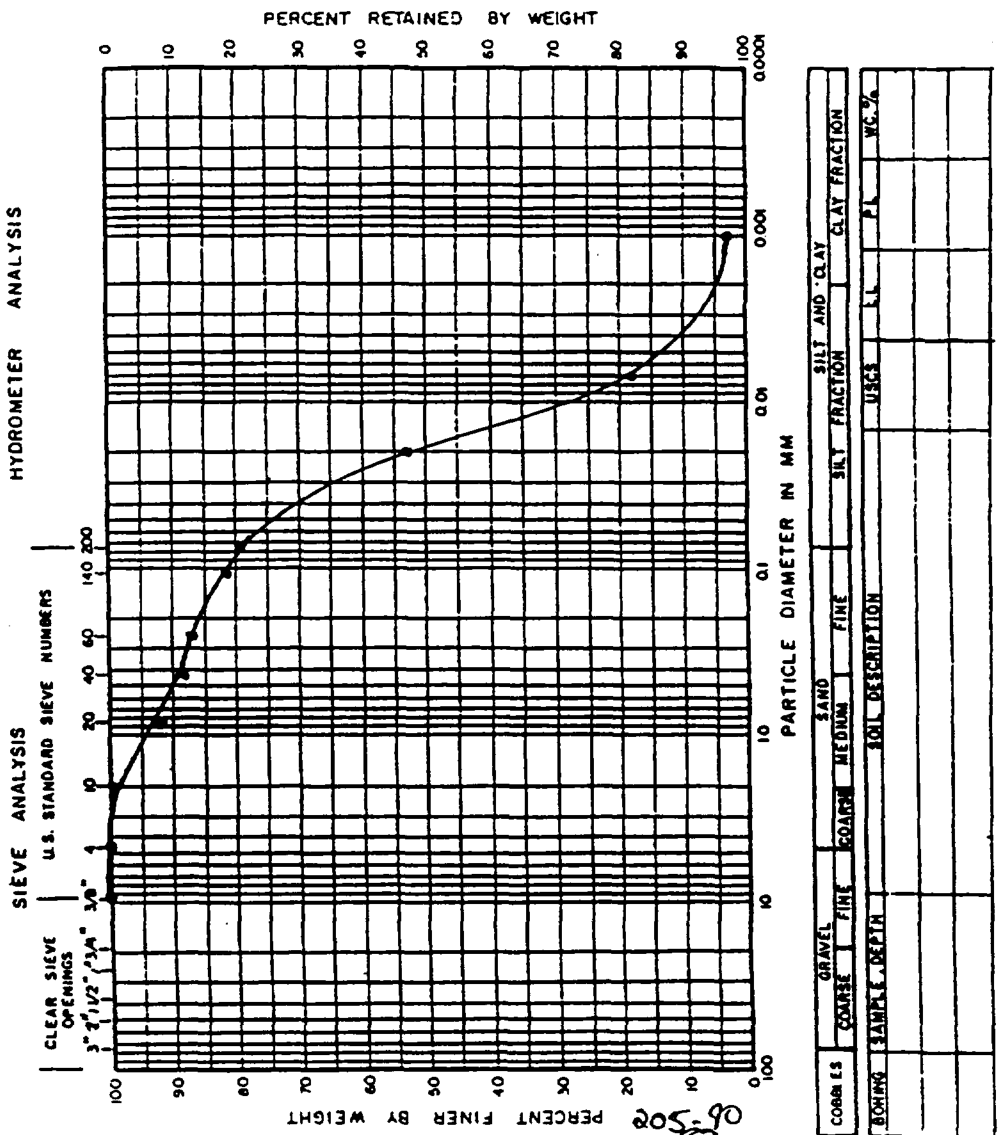
Boring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

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Laboratory No. P151886 Sheet ______ of ______

NUS CORPORATION

roject Name: Geraghty & Miller | Project No. Pond 5-A | Tested By DW | Date 12/9/90

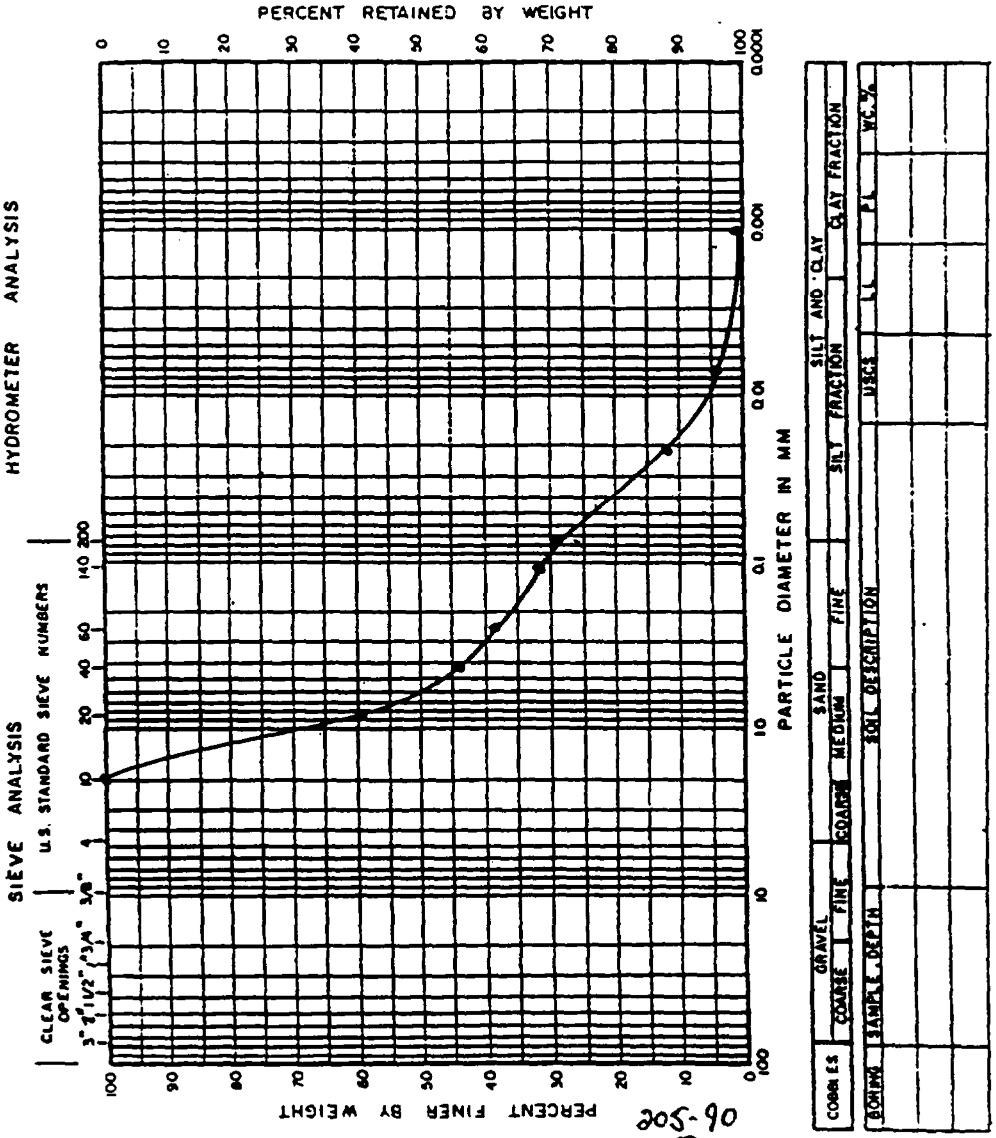
Boring/Test Pit No. ______ | Sample No. ______ | Calculated By DW | Date 1/2/91

Sample Depth ______ | Sample Type ______ | Checked By JCL | Date 8 JAN 91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



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NUS CORPORATION

Laboratory No. A51887 Sheet ______ of ______

Project Name: Geraghty & Miller Project No. Pond 5-B Tested By DN Date 12/9/90

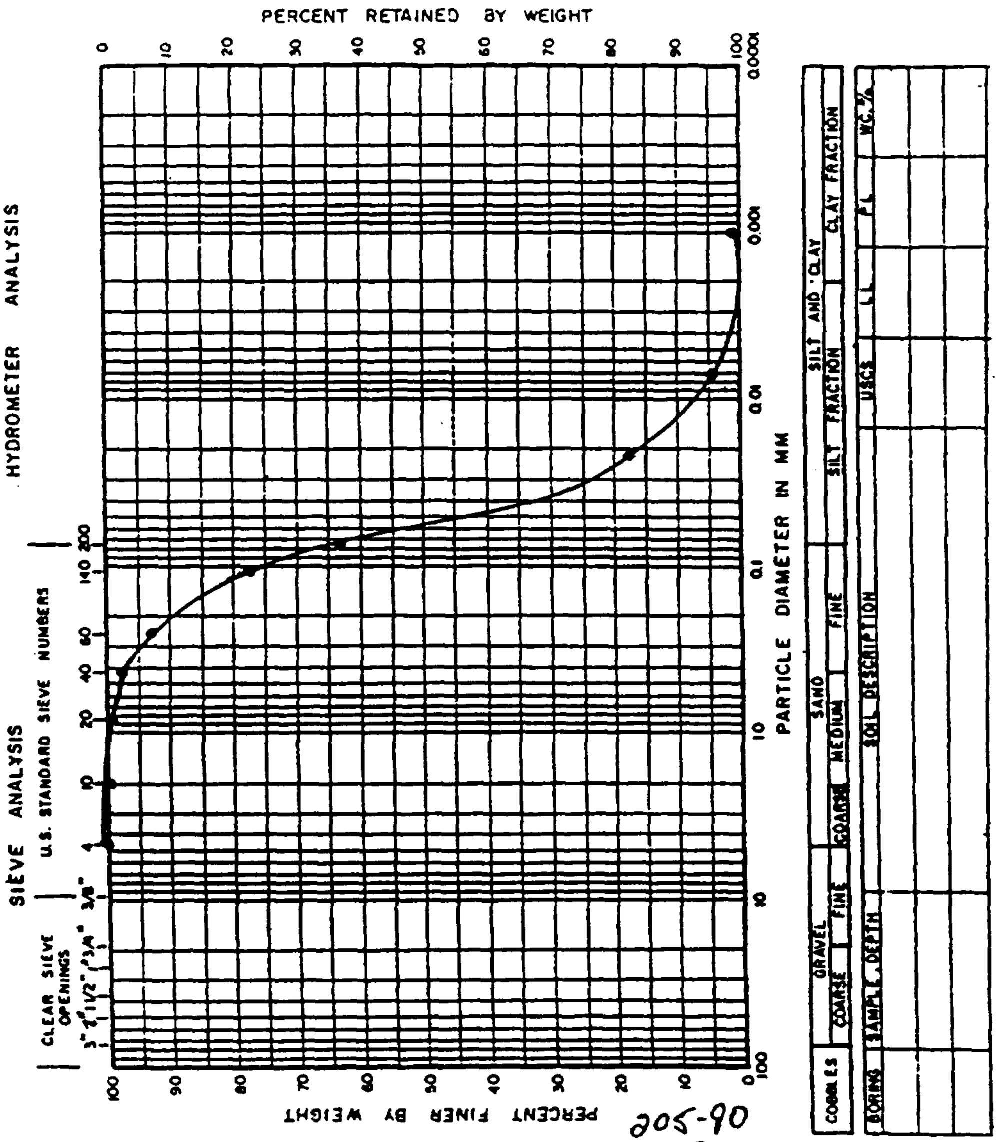
Boring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8 JAN 91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



06-502

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NUS CORPORATION

Laboratory No. P151888 Sheet ____ of ____

Project Name: Geraghty & miller Project No Pond 5-C Tested By DW Date 12/19/90

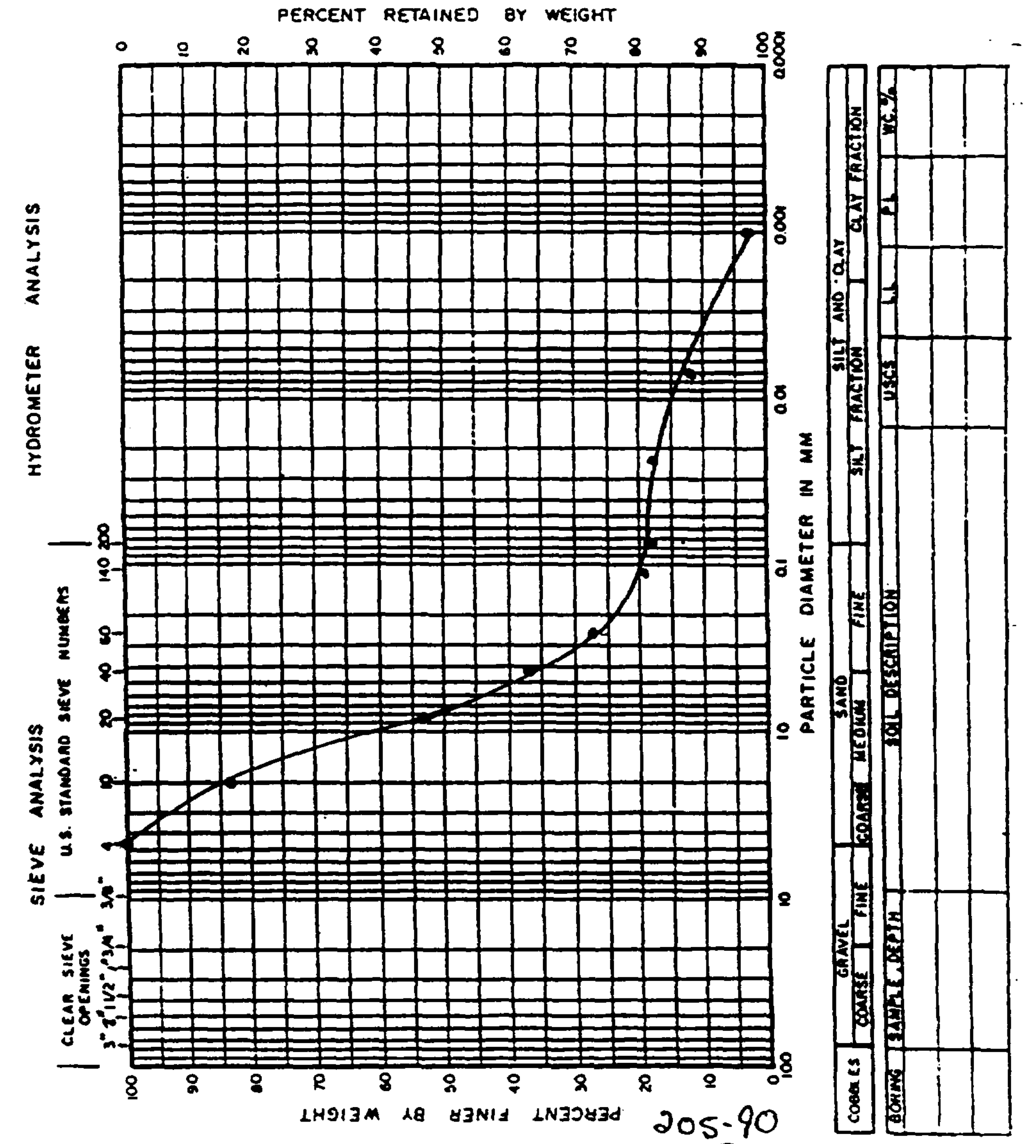
Boring/Test Pit No. ____ Sample No. ____ Calculated By DW Date 1/2/91

Sample Depth ____ Sample Type ____ Checked By JCL Date 8JAN91

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

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NUS CORPORATION

Laboratory No. P151889 Sheet ______ of ______

Project Name: Geraghty & miller Project No. Pond 5-D Tested By DN Date 12/9/90

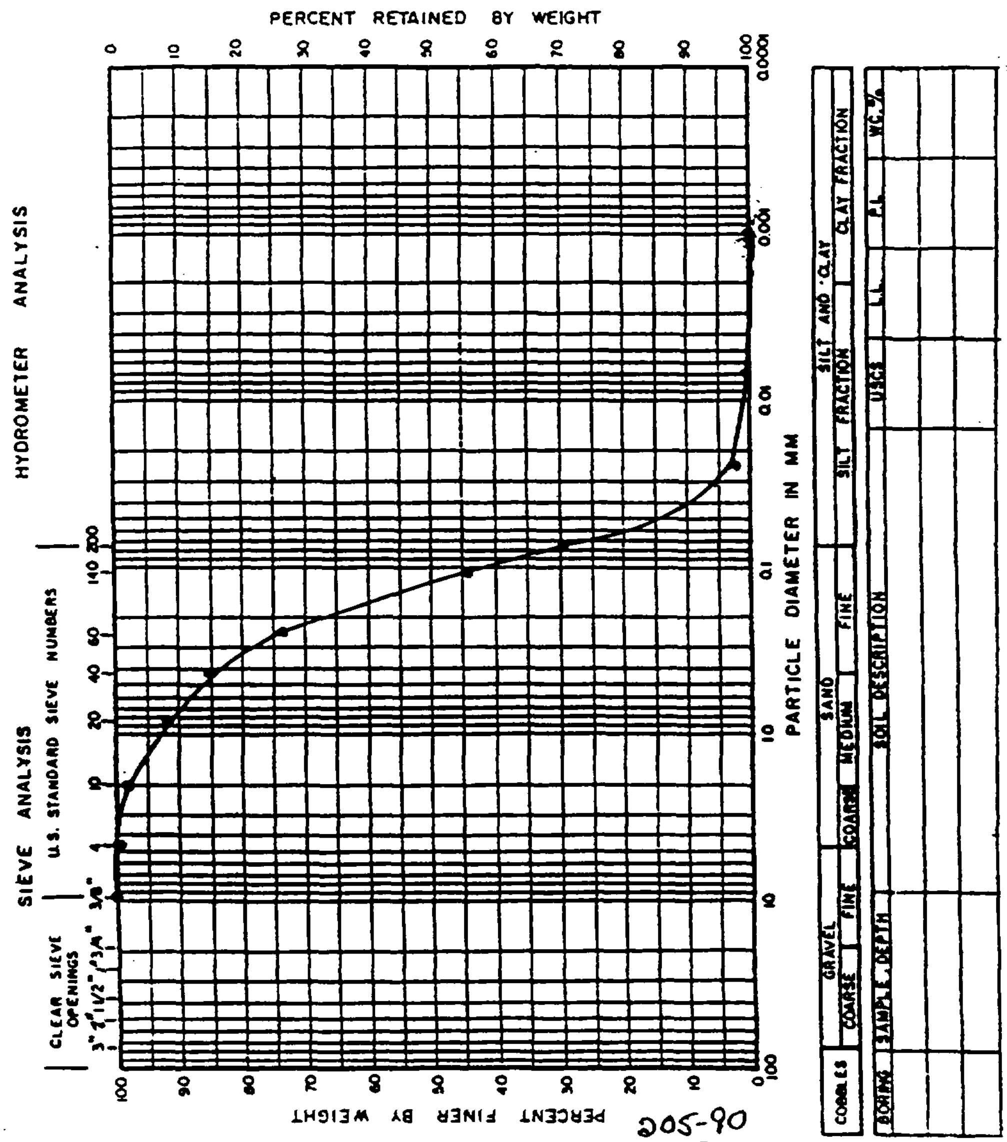
Boring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



06-50G

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Laboratory No. P151890 Sheet ______ of ______

NUS CORPORATION

Project Name: Geraghty & miller Project No. Pond 5-E Tested By DN Date 12/9/90

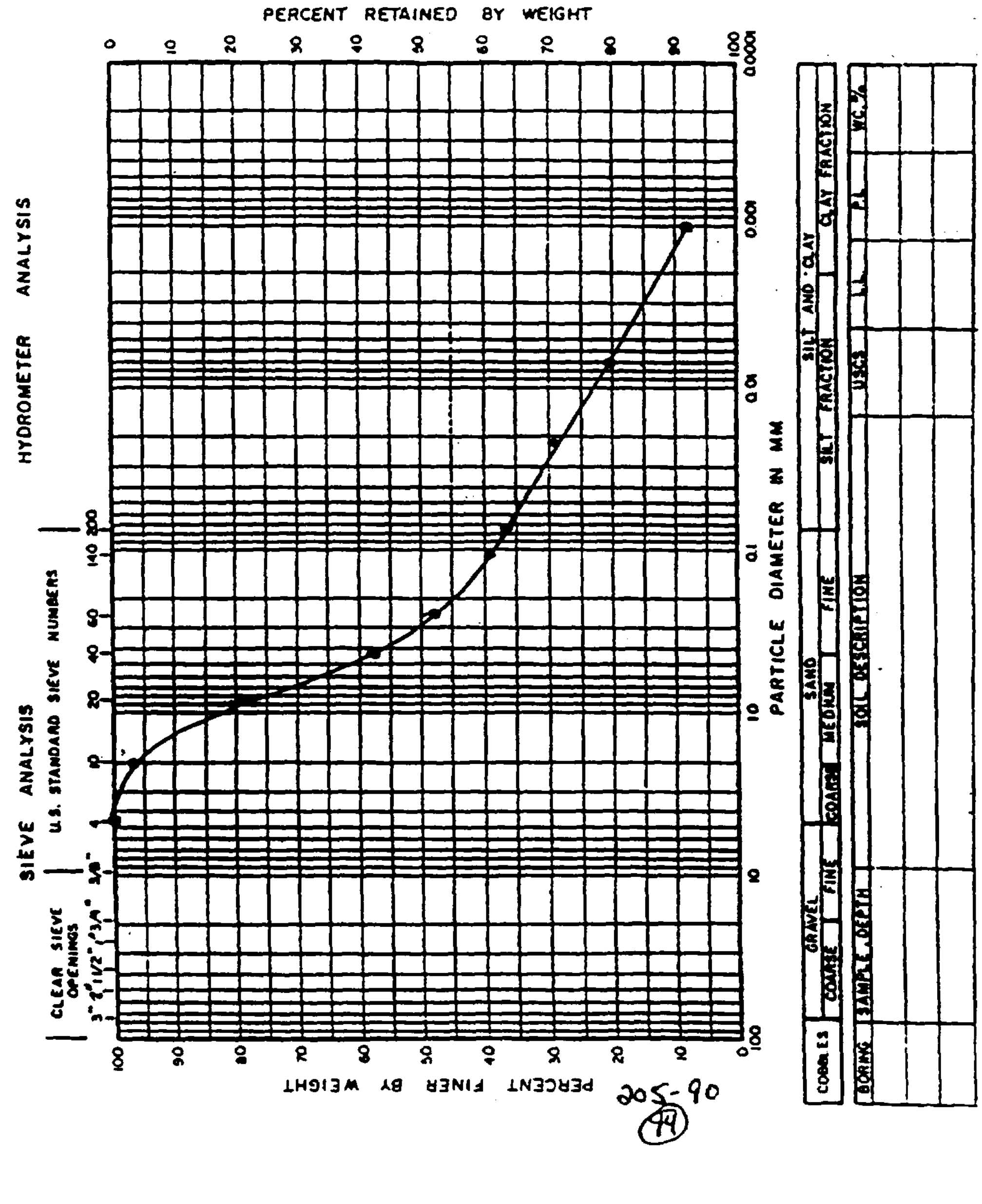
Boring/Test Pit No. ______ Sample No. ______ Calculated By DN Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

(44)

Laboratory No. P151891   Sheet ____ of ____

NUS CORPORATION

Project Name: Geraghty & miller   Project No. SB-006   Tested By DN   Date 12/8/90

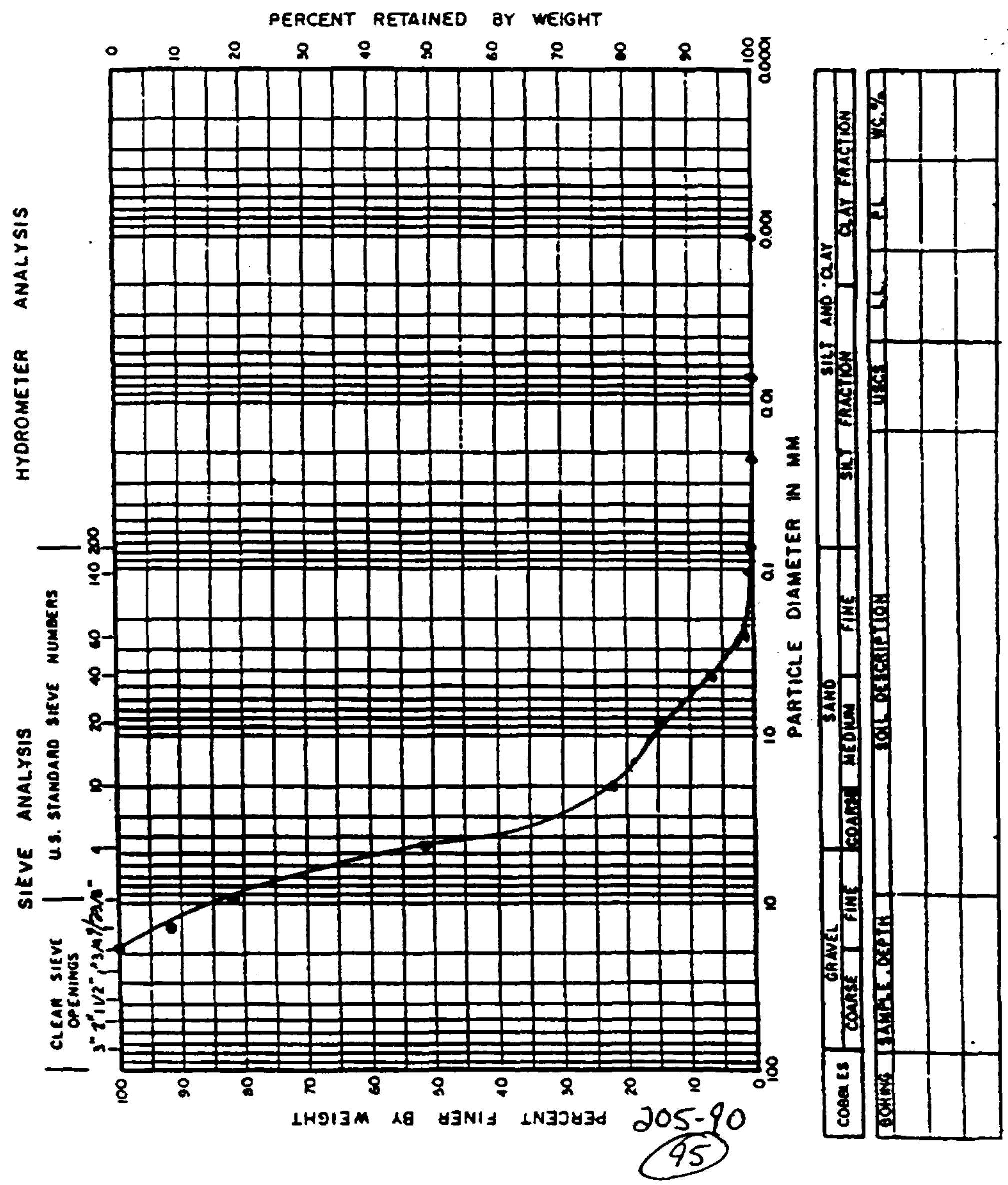
Boring/Test Pit No. ____   Sample No. ____   Calculated By DN   Date 1/2/91

Sample Depth ____   Sample Type ____   Checked By JLL   Date 8JAN91

Sample Description ____

Sample Preparation Method ____

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



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NUS CORPORATION

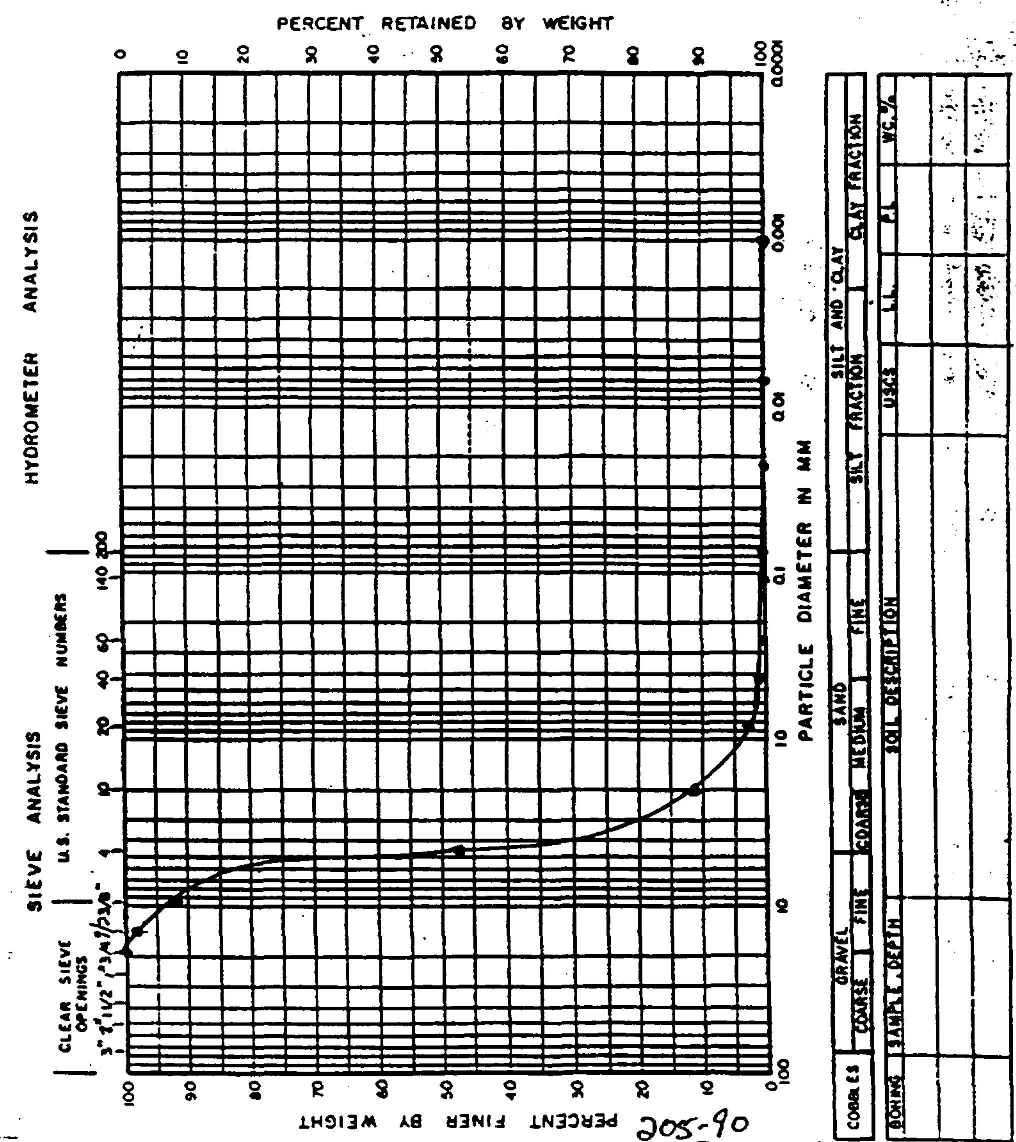
Laboratory No. P151892 Sheet ______ of ______

Project Name:	Geraghty & Miller	Project No. 5B-008	Tested By DN	Date 12/9/90	
Boring/Test Pit No.		Sample No.	Calculated By DN	Date 1/2/91	
Sample Depth		Sample Type	Checked By JCL	Date 8JAN91	

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



205-90

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Laboratory No. P151893   Sheet ______ of ______

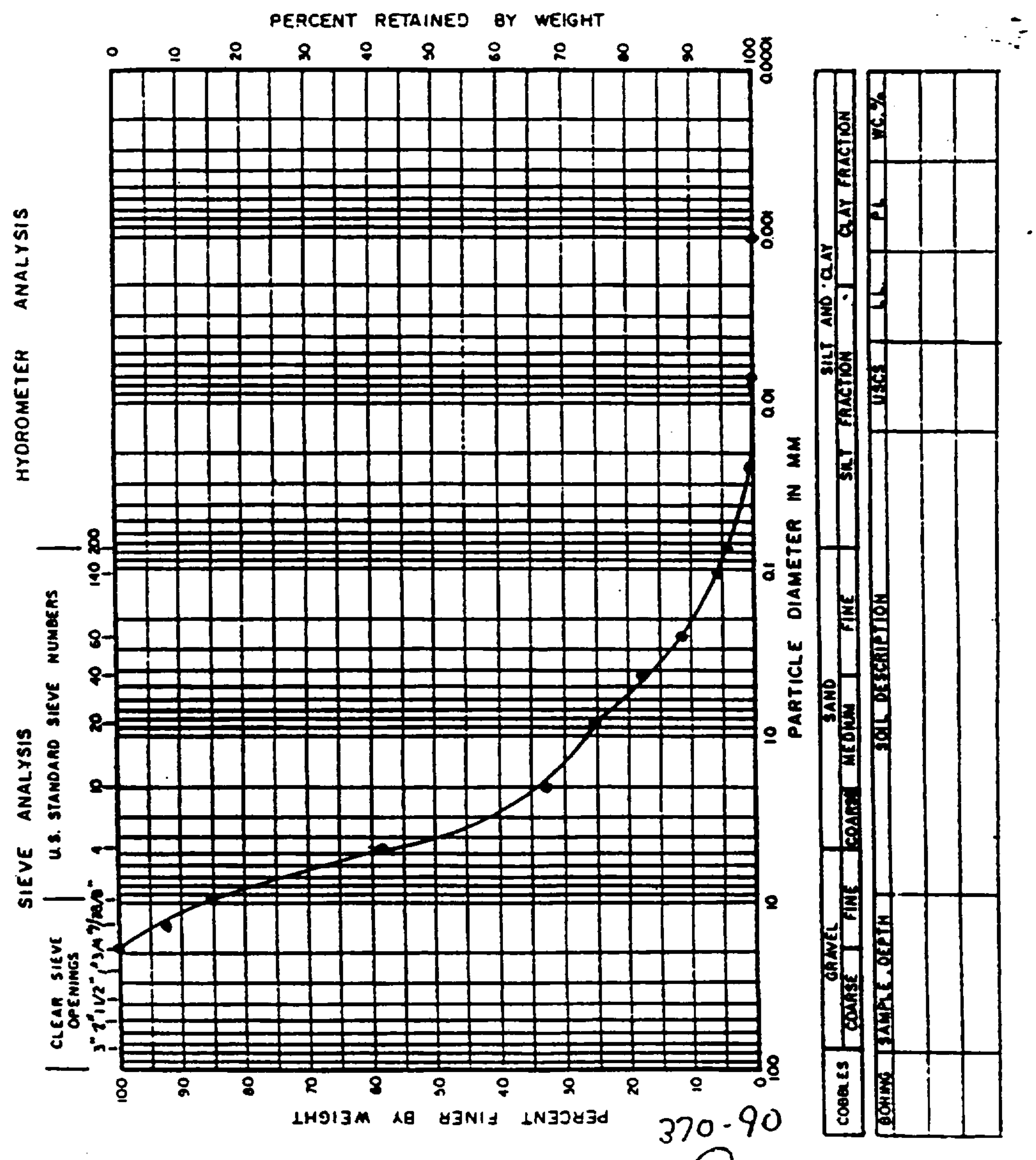
NUS CORPORATION

Project Name:	Geraghty & miller	Project No.	SB-015	Tested By	DN /	Date 12/9/90
Boring/Test Pit No.		Sample No.		Calculated By	DN /	Date 1/2/91
Sample Depth		Sample Type		Checked By	JCL	Date 8 JAN 91

Sample Description ____________________

Sample Preparation Method ____________________

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



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(1)

NUS CORPORATION

Laboratory No. P151894 Sheet ______ of ______

Project Name: Geraghty & Miller Project No. SB-016 Tested By DW Date 12/9/90

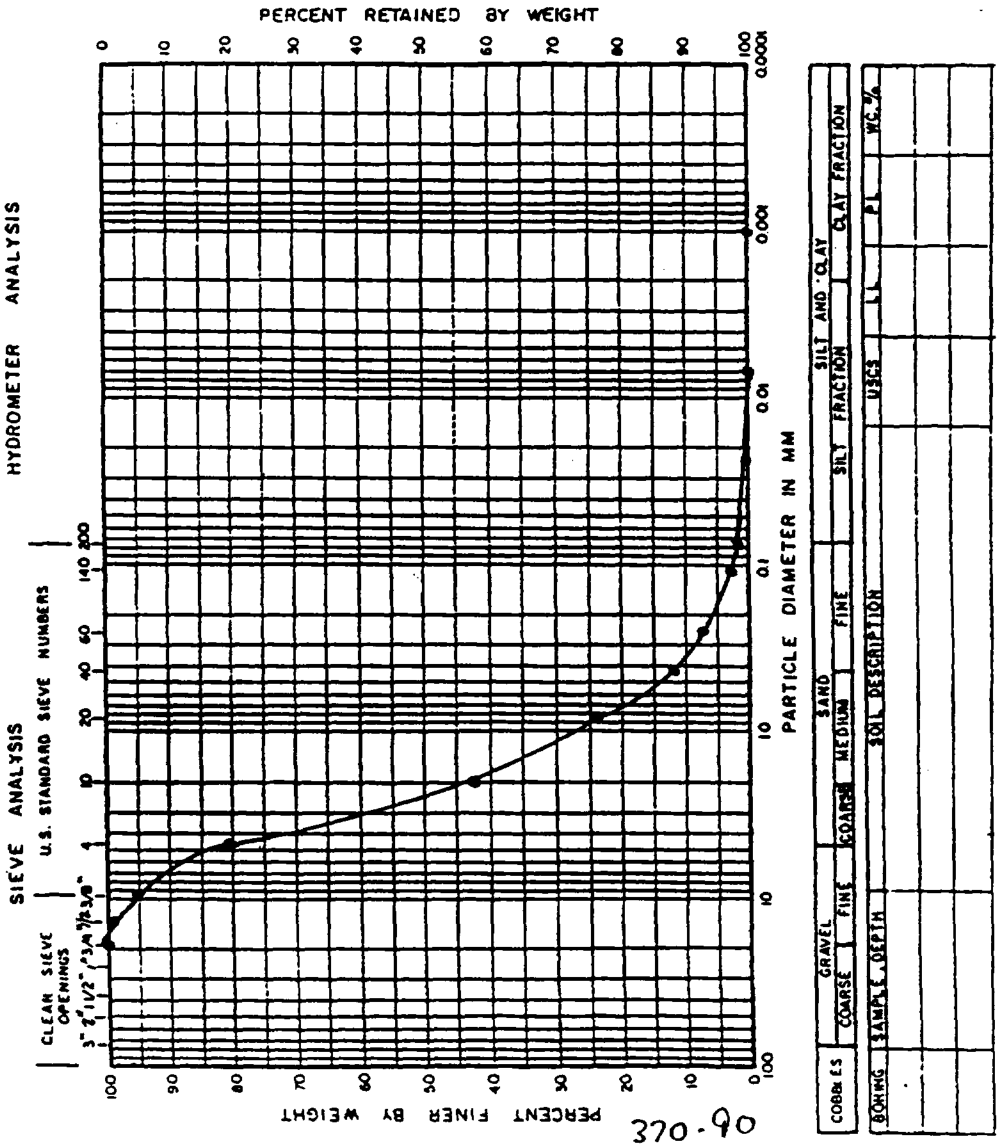
Boring/Test Pit No. ______ Sample No. ______ Calculated By DW Date 1/2/91

Sample Depth ______ Sample Type ______ Checked By JCL Date 8JAN91

Sample Description ______

Sample Preparation Method ______

GRAIN SIZE ANALYSIS – COHESIVE MATERIAL



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(2)

WATER DIVISION
POTENTIAL ARARs

Location	Citation	N/A	Review Requested	Comments
Wetlands	CWA 404 40CFR 230 33CFR 320-330 40CFR 6 EO 11988 EO 11990			
Action				
Discharge of treatment system effluent	40CFR 122.44 125.100 .104 122.41i 136.1-136.4			
Discharge to publically owned treatment works	40CFR 403.5+ local regulations			
Discharge of dredge and fill material to waters of the U.S.	40CFR 230 33CFR 320-330			
Dredging	33 USC 403 33CFR 320-330			
Underground injection of wastes and treated groundwater	40 CFR 144.12 .13 .16 .28b .51 .28g .55 146.4 144.28e 146.12d .13 147			

Chemical Specific	Citation	N/A	Review Requested	Comments
SDWA Maximum Contaminant Levels	40CFR 141.11-.16			
CWA water quality criteria	CWA 304 51 FR 43665			

AIR & RADIATION DIVISION
POTENTIAL ARARs

Action	Citation	N/A	Review Requested	Comments
Air stripping	CAA 109 110 111 112 107 40CFR 51.160- .164 60.50 52 51.166			
Thermal destruction	CAA 109 110 111 112 107 40CFR 51.160- .164 60.50 52 51.166			
Soil handling	CAA 109 110 111 112 107 40CFR 51.160- .164 60.50 52 51.166 UMTRCA 40CFR 192			
Gaseous waste treatment	CAA 109 110 111 112 107 40CFR 51.160- .164 60.50 52 51.166			

Chemical Specific	Citation	N/A	Review Requested	Comments
National Ambient Air Quality Standards	CAA 109 40CFR 50			
National Emissions Standards for Hazardous Air Pollutants	CAA 112 40CFR 61			
New Source Performance Standards	CAA 111 40CFR 60			
Radiation Control	UMTRCA 40CFR 192			

ENVIRONMENTAL SCIENCES DIVISION
POTENTIAL ARARs

Location	Citation	N/A	Review Requested	Comments
New PCB landfill	TSCA 6 40CFR 761			
Action				
Construction of a PCB landfill on-site	40CFR 761.75			
Discharge of dredge and fill material containing PCBs	40CFR 761.60			
Incineration of PCBs	40CFR 761.70			
Treatment/ disposal of PCBs	40CFR 761.60			
Storage of PCBs	40CFR 761.65			

OTHER POTENTIAL ARARs

Location	Citation	N/A	Review Requested
Within floodplain	Fish & Wildlife Coordination Act(FWLCA)		✓
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	National Historic Preservation Act(NHPA) 36CFR 65		
Historic project owned or controlled by Federal agency	NHPA 36CFR 800		
Critical habitat upon which endangered species or threatened species depends	Endangered Species Act of 1973 50CFR 200 402 FWLCA 33CFR 320-330		
Wetlands	33CFR 320-330		
Wilderness area	Wilderness Act 50CFR35.1		
Wildlife refuge	50CFR27		
Area affecting stream or river	Wild & Scenic Rivers Act 40CFR 6.302a		

Federal Chemical Specific ARARs for Groundwater

<u>Title of Regulation</u>: Safe Drinking Water Act (SDWA) (Maximum Contaminant Levels 40 CFR 141.11 -141.16)

<u>Description of Regulation</u>: Enforceable standards for a public water system. Maximum contaminant levels are generally considered "relevant and appropriate" to ground water that is or may be used for drinking water.

<u>Application of Regulation</u>: Pertains to any site which has contaminated ground or surface water that is either being used, or has the potential for use, as a drinking water source.

<u>Title of Regulation</u>: SDWA (Maximum Contaminant Level Goals 40 CFR 141.50 - 141.51)

<u>Description of Regulation</u>: Non-enforceable health goals for public water systems. Non-zero MCLGs promulgated under SDWA are potentially relevant and appropriate to ground water contamination.

<u>Application of Regulation</u>: Pertains to any site which has contaminated ground or surface water that is either being used, or has the potential for use, as a drinking water source. (A. Sanders, 6-4239)

Federal Action Specific ARARs for Dredging

Clean Water Act 404 Requirements

Site Action	Requirements	Source or Governing Regulations
Storage of PCBs and PCB items (continued)	PCB articles and containers shall be dated when they are placed in storage. Records shall be kept of PCB movements into and out of each storage container.	40 CFR §761.65(c)(8)
	Containers used to store liquid PCBs (over 50 ppm) shall meet one of the following criteria:	40 CFR §761.65(c)(6)
	• DOT Spec 5 container without removable head;	49 CFR §178.80
	• DOT Spec 5B container without removable head;	49 CFR §178.82
	• DOT Spec 6D overpack with Spec 2S or 2SL polyethylene containers; or	49 CFR §178.102, 178.35
	• DOT Spec 17E container.	49 CFR §178.116
	Standard size containers used to store nonliquid PCBs shall meet one of the following criteria:	40 CFR §761.65(c)(6)
	• DOT Spec 5;	49 CFR §178.80
	• DOT Spec 5B; or	49 CFR §178.82
	• DOT Spec 17C.	49 CFR §178.115
	Larger containers used to store liquid PCBs shall:	40 CFR §761.65(c)(7)
	• Be designed, constructed, and operated to meet OSHA 29 CFR §1910.106 requirements for flammable + combustible liquids; and	40 CFR §761.65(c)(7) (continued)
Storage of PCBs and PCB items	PCB containers and PCB storage areas shall be labeled with Mark M_L (or Mark M_s if M_L is too big to fit on the container).	Authority: Toxic Substances Control Act (TSCA), Code of Federal Regulations Title 40 (40 CFR) 40 CFR §761.65(b)(3), 761.40(a)

Site Action	Requirements	Source or Governing Regulations
Storage of PCBs and PCB items (continued)	• Also, a Spill Prevention Control and Countermeasures (SPCC) Plan (see 40 CFR § 112) shall be prepared and implemented.	40 CFR § 761.65(b)(7)(ii)
	All stored PCB articles and PCB containers shall be checked for leaks at least once every 30 days. Any leaking PCB articles or containers and their contents shall be transferred immediately to properly marked non-leaking containers. Spills shall be immediately cleaned up.	40 CFR § 761.65(b)(5)
Container storage of hazardous wastes for more than 90 days.	Containers must be maintained in good condition.	Authority: Resource Conservation and Recovery Act (RCRA) 40 CFR § 264.171 OAC 3745-55-71
	Containers must be compatible with the material stored.	40 CFR § 264.172 OAC 3745-55-72
	Containers must be closed during storage. Containers must be opened, handled and stored to prevent ruptures and leaks.	40 CFR § 264.173 OAC 3745-55-73
	Containers must be inspected weekly for deterioration and leaks.	40 CFR § 264.174 OAC 3745-55-74
	Containers holding ignitable or reactive waste must be located at least 50 feet from the facility's property line, and precautions to prevent ignition shall be taken.	40 CFR § 264.176 OAC 3745-55-76

Site Action	Requirements	Source or Governing Regulations
Tank storage of hazardous wastes and vault storage of dioxin-contaminated materials	Tanks with no secondary containment that hold hazardous wastes must have sufficient structural strength and be compatible with the stored waste in order to ensure that they do not collapse, rupture, or fail.	40 CFR §264.191 OAC 3745-55-91
	Uncovered tanks must have sufficient freeboard to prevent overtopping by wave or wind action or by precipitation.	40 CFR §264.194 OAC 3745-55-94
	Inspection of tank overfill controls must be scheduled, performed and recorded.	40 CFR §264.195 OAC 3745-55-95
	Daily inspection of visible portions of tanks, and surrounding areas.	40 CFR §264.196 OAC 3745-55-96
	A tank or secondary containment system that has leaked/spilled must be removed from service immediately. Waste must be removed from the tank or containment system within 24 hours to prevent further leaks/spills, and to allow for inspection and repair.	
	Ignitable and reactive waste shall be stored to prevent the waste from igniting or reacting. Owner/operators shall comply with buffer zone requirement in "Flammable and Combustible Liquids Code." Table 2-1 through 2-6 (National Fire Protection Association, 1977 or 1981).	40 CFR §264.198 OAC 3745-55-98

Site Action	Requirements	Source or Governing Regulations
Equipment Used for Handling PCBs	Movable equipment that comes in direct contact with PCB material shall be decontaminated as described in §761.79 before being removed from the Exclusion Zone at the site.	Authority: TSCA 40 CFR §761.65(b)(4)
	Movable equipment shall be decontaminated by swabbing surfaces that have contacted PCBs with a solvent. The solvent may be reused for decontamination until it contains 50 ppm PCB. The solubility of PCBs in the solvent must be five percent or more by weight. The solvent and any non-liquid PCBs resulting from the decontamination shall be disposed of properly.	40 CFR §761.79(b)
TANK DISMANTLING AND DISPOSAL		
Decontamination of PCB Containers	Any PCB container to be decontaminated shall be decontaminated by flushing the internal surfaces of the container three times with a solvent containing less than 50 ppm PCB. The solubility of PCBs in the solvent must be five percent or more by weight. Each rinse shall use a volume equal to approximately ten percent of the PCB container capacity. The solvent may be reused for decontamination until it contains 50 ppm PCB. The solvent shall then be disposed of properly. Non-liquid PCBs resulting from the decontamination procedures shall be disposed of properly.	40 CFR §761.79(a)

Site Action	Requirements	Source or Governing Regulations
INCINERATION		
Incineration of liquid PCBs at concentrations of 50 ppm or greater.	Approval from U.S. EPA is required prior to operation. A trial burn will be required.	Authority: TSCA, 40 CFR §761.70(a)(b)and (d)
	Performance, monitoring, and operating requirements are described in the following paragraphs.	40 CFR §761.70(a)
	Combustion criteria shall be either of the following:	40 CFR §761.70(a)(1)
	• Maintenance of the introduced liquids for a 2-second dwell time at 1200°C (±100°C) and 3 percent excess oxygen in the stack gas; or	40 CFR §761.70(a)(2)
	• Maintenance of the introduced liquids for 1½-second dwell time at 1600°C (±100°C) and 2 percent excess oxygen in the stack gas.	
	The combustion efficiency shall be at least 99.9% computed as follows: $([CO_2]/[CO_2] + [CO])\ 100$.	40 CFR §761.70(a)(2)
	Records of all measurements described here shall be maintained for 5 years.	40 CFR §761.180(c)(3)
	The rate and quantity of PCBs fed to the combustion system shall be measured and recorded at regular intervals of no longer than 15 minutes.	40 CFR §761.70(a)(3) and 40 CFR §761.180(c)(1)(i)

Site Action	Requirements	Source or Governing Regulations
Incineration of liquid PCBs at concentrations of 50ppm or greater (continued).	Incineration process temperatures shall be continuously measured and monitored.	40 CFR §761.70(a)(4) and 40 CFR §761.180(c)(1)(ii)
	An automatic waste feed cutoff system shall be used to stop the flow of PCBs to the incinerator when the following occurs:	40 CFR §761.70(a)(5) and (8)
	• The temperature drops below the required combustion temperature;	40 CFR §761.70(a)(6) and 40 CFR §761.180(c)(2)
	• Failure of CO, O_2 and CO_2 monitoring;	
	• Failure of PCB rate and quantity monitoring; or	
	• Excess oxygen falls below required levels.	
	Stack emissions shall be monitored:	
	• When an incinerator is first used for PCB disposal; and	
	• When an incinerator is first used after modification.	
	At a minimum O_2, CO, CO_2, NO_x, HCl, RCl, PCBs, and total particulate matter shall be monitored.	
	O_2 and CO levels in the combustion gas streams shall be continuously monitored and recorded.	40 CFR §761.70(a)(7) and 40 CFR §761.180(c)(1)(iii)

Site Action	Requirements	Source or Governing Regulations
Incineration of liquid PCBs at concentrations of 50 ppm or greater (continued).	CO_2 levels in the combustion gas stream shall be periodically monitored and recorded, as required by the EPA. Water scrubbers shall be used for HCl control during incineration, and shall meet any performance requirements specified by the EPA. Scrubber effluent shall be monitored and shall be disposed of properly.	49 CFR § 761.70(a)(9)
Incineration of nonliquid PCBs at concentrations of 50 ppm or greater.	Requirement in addition to those described for liquids: • The mass air emissions from the incinerator shall be no greater than .001 g PCB/kg of the PCB introduced into the incinerator. Operation of an incinerator for nonliquid PCBs will comply with the following requirements described for liquids: • Automatic waste feed cutoff for reasons of temperature, or excess oxygen. • Automatic waste feed cutoff if the excess O_2 falls below required levels.	40 CFR § 761.70(b)

Site Action	Requirements	Source or Governing Regulations
Incineration of PCBs, liquid and non-liquid.	Records shall be kept for 5 years of the following:	40 CFR §761.180(c)(3)
	• Total weight in kilograms of solid residues generated by incineration during each calendar year;	
	• Total weight (kg) of solid residues sent to PCB landfills;	
	• Total weight (kg) of solid residues remaining on site.	
	Records shall be kept for 5 years of the following information:	40 CFR §761.180(c)(4)
	• Additional periodic data collected during operations as required by the EPA for the incinerator; and	40 CFR §761.180(c)(4)
	• Incinerator operation suspensions due to failure of monitoring equipment or low excess oxygen. A report shall be prepared that includes the date, time, and cause, and shall be sent to the EPA within 30 days.	40 CFR §761.180(c)(5)
Incineration of hazardous wastes.	Approval from U.S. EPA is required prior to operation. A trial burn will be required.	40 CFR § 270.62
	Analyze the waste feed to verify that it is within the allowed physical and chemical composition required to achieve the performance standards.	Authority: RCRA 40 CFR §264.341

Site Action	Requirements	Source or Governing Regulations
Incineration of hazardous wastes. (continued)	Incinerator Performance Standards are as follows:	40 CFR §264.343
	• Achieve a 99.99% destruction and removal efficiency for each principal organic hazardous constituent in the waste feed and 99.9999% for dioxin.	40 CFR §264.342
	• Limit hydrogen chloride emissions to 1.8 kg/hr or 1 percent of HCl in the stack gas before entering any pollution control device.	
	• Limit particulate matter emissions to 0.08 grains/dscf corrected for amount of oxygen in the stack gas.	40 CFR §264.343
	The following parameters shall be monitored during operation of the incinerator:	40 CFR §264.343
	• Combustion temperature;	
	• Waste feed rate;	
	• An indicator of combustion gas velocity; and	
	• Carbon monoxide level in stack exhaust gas.	
	Fugitive emissions shall be controlled either by:	40 CFR §264.345
	• Keeping the combustion zone sealed; or	
	• Maintaining a combustion zone pressure lower than atmospheric pressure.	

Site Action	Requirements	Source or Governing Regulations
Incineration of hazardous wastes (continued).	An automatic cutoff system shall be used to stop waste feed when operating conditions deviate from U.S. EPA approved operating limits or if any of the required continuous monitoring devices malfunction.	40 CFR §264.345
Air pollution source requirements that apply to the incinerator.	Maintenance. Any shutdown of air pollution control equipment for maintenance work shall be approved in advance. Requests shall be submitted at least 2 weeks in advance.	Authority: Clean Air Act (CAA), as amended OAC 3745-15-06.
	Malfunctions. Malfunctions of air pollution control equipment that violate a law shall be reported immediately. If a malfunction lasts 72 hours or more, a report must be submitted (within 2 months) that explains how similar malfunctions will be prevented in the future.	OAC 3745-15-06
	Nuisance. Emission or escape of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, or other substances that endanger the health, safety, or welfare of the public, or cause damage to property, is a nuisance, and is unlawful.	OAC 3745-15-07
	TSP. The primary and secondary ambient air quality standards for total suspended particulates shall not be exceeded.[4]	OAC 3745-17-02 OAC 3745-17-05

Site Action	Requirements	Source or Governing Regulations
Air pollution source requirements that apply to the incinerator (continued).	Visible emissions. Stack emissions cannot exceed 20% opacity except, inter alia, 1) when fuel burning equipment experiences a malfunction, and 2) for 6 minutes per hour the opacity may be 60%. It is not a violation if the presence of uncombined water is the only reason this rule can't be met.	OAC 3745-17-07
	Emissions from incinerators. The limit on particulate emissions is 0.10 lb/100 lbs of solid or liquid charge. The incinerator is to be designed, operated, and maintained to prevent emission of objectionable odors.	OAC 3745-17-09
	SO_2. The primary and secondary ambient air quality standards for sulfur dioxide shall not be exceeded.[4]	OAC 3745-18-02
	Measurement methods. Methods outlined in these regulations will be used to measure SO_2.	OAC 3745-18-04
	CO. The primary and secondary ambient air quality standards for carbon monoxide shall not be exceeded.[4]	OAC 3745-21-02
	Measurement methods. Methods outlined in these regulations will be used to measure CO.	OAC 3745-21-03
	Organic materials. Emissions of photochemically reactive materials from new stationary sources shall be minimized by use of the latest available control techniques and operating practices in accordance with best current technology.	OAC 3745-21-07

Air pollution source requirements that apply to other work at the site.	Requirements of the National Emission Standards for Hazardous Air Pollutants for asbestos apply to the demolition of the boiler house because of the presence of significant quantities of asbestos containing materials.	Authority: Clean Air Act 40 CFR §61.145, 61.146 and 61.147.
WATER AND WASTEWATER TREATMENT		
Wastewater from the drums, tanks and pits, decontamination water and incinerator scrubber water that is pumped to tank trucks for transport to an off-site hazardous waste treatment facility.	DOT and off-site treatment and disposal requirements must be met.	Authority: Transportation A RCRA 49 CFR Parts 171-177
ASH DISPOSAL		
Ash that is disposed of on site.	No requirements apply if the ash is "delisted".	Authority: RCRA. 40 CFR § 264.22,264.100
Hazardous wastes will be disposed of at an off-site RCRA-licensed landfill.	BDAT for the specific listed hazardous wastes identified at this site is based on incineration which is the remedial technology selected for source control at the site. RCRA wastes treated to BDAT standards may be disposed of to land.	40 CFR 268.30 et seq.

APPENDIX C

FEDERAL ARARs

U.S. EPA

RCRA PERMITTING BRANCH
POTENTIAL RCRA ARARs

Location	Citation	N/A	Review Requested	Comments
Within 200 feet of fault zone	40CFR 264.18a			
Within 100-yr floodplain	40CFR 264.18b		✓	
Within salt dome formation, underground mine or cave	40CFR 264.18c			
Action				
Capping/Closure with waste in-place	40CFR 264.228a .258b .310a .228a .117c .228b .310b			
Closure with no post-closure care (clean closure)	40CFR 264.111 .178 .197 .288o .258			
Closure with waste in-place	40CFR 264.228 .258b .310			
Closure of land treatment units	40CFR 264.280			
Consolidation within a Unit		X		
Consolidation between Units				

Action	Citation	N/A	Review Requested	Comments
Container storage	40CFR 264.171 .172 .173 .174 .175 .176 268.50			
Construction of new landfill on-site -minimum technology -gw monitoring	40CFR 264.301 .303 .304 .310 .91- .100			
Construction of new surface impoundment -minimum technology -gw monitoring	40CFR 264.220 .221 .91- .100			
Dike stabilization	40CFR 264.221 .226 .227 .228			
Discharge to publically owned treatment works	40CFR 270.60			
Excavation	40CFR 268			
Groundwater diversion				
Incineration	40CFR 264.341 .351 .340 .343 .342 .345			
Land treatment	40CFR 264.271 .273 .276 .278 .281 .283			

Action	Citation	N/A	Review Requested	Comments
Operation & Maintenance	40CFR 264.310			
Placement of liquid waste in landfill	40CFR 264.314			
Placement of waste in land disposal unit	40CFR 268			
Slurry wall				
Surface water control	40CFR 264.251 .273 .301 .221c			
Tank storage	40CFR 264.190 .191 .193- .198 268.50			
Treatment(in a unit)	40CFR 264.190- .192 .221 .251 .273 .343- .345 .601 .373			
Treatment(when waste will be land disposed	40CFR 268.10- .12 .41 268 51FR 40641 52FR 25760 40CFR 268.30			
Underground injection	40CFR 268.2			
Waste pile	40CFR 264.251 268.2			

Chemical Specific	Citation	N/A	Review Requested	Comments
Maximum concentration limits	40CFR 264.94			